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## A STUDY OF URETERAL IMPLANTATION

WITH A DESCRIPTION OF A NEW PROCEDURE\*

A PRELIMINARY REPORT

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NEW YORK

THE study of congenital anomalies has always exercised a great fascination over both lay minds and medical. Until the age of Roentgen most of these were the findings of the autopsy table, and thus exercised but little influence upon medicine or surgery clinically applied. A conspicuous exception to this was ectopia vesicae, exstrophy of the bladder. This greeted the astonished gaze of the ancient Egyptian accoucheur and caused consternation to the Renaissance midwives whose patients numbered among them the consorts of kings. The occurrence of this congenital malformation has been noted ever since medical history began to be written. Naturally therefore, it is also the one toward which the earliest attempts to afford relief of its most distressing consequences have been directed. During a long period these efforts were confined solely to attempts to draw the gaping pubic bones together, or in some other way to supply an anterior wall to the bladder. The effort seldom succeeded and even if it did, the paramount problem of urinary incontinence still remained. Though it had long been known that in reptiles and birds a single duct serves to convey both urine and feces from the body, and that very early in human embryonic life one excretory tract serves

all purposes, it was not until the middle of the nineteenth century that the possibility of treating bladder exstrophy by artificial reproduction of this condition was perceived. At this time the history of ureteral transplantation may be said to have begun.

### CHRONOLOGY OF ATTEMPTS TO IMPLANT THE URETERS IN THE LOWER BOWEL

The history of uretero-intestinal anastomosis has been presented more or less completely by a number of authors. The first complete monograph on the subject appears to be that of Peterson, which brings the subject down to the beginning of the present century. Steinke in 1909 and Buchanan at almost the same time presented less elaborate but nevertheless complete historical summaries. From time to time thereafter the subject was reviewed under studies of exstrophy of the bladder, the most notable of these being C. H. Mayo's contribution to the Osler Anniversary volume; Stevens in 1916 and the Hutchins brothers in 1923 also reported cases of ureteral transplantation for bladder exstrophy and gave summaries of literature. The historical material which follows has been largely gathered from the sources just mentioned, though in case of doubt or disagreement, recourse

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has been had to original sources in so far as they are available.

Anastomosis between ureter and bowel was preceded by the attempt to establish a ureterorectal fistula. The surgical procedure known during the seventeenth and eighteenth centuries as "cutting for the stone" and still popular until within the memories of those who are still with us in extreme old age, not infrequently left intractable fistulae between organs adjacent to the site of operation. It had been noted in certain cases where the rectum and urinary apparatus were thus placed in communication that it was possible for the patient to control the urine which leaked into the rectum by means of the anal sphincter, and that the rectal mucosa seemed to be tolerant of the presence of urine. The procedure carried out by Lloyd, October 3, 1851, was an attempt to establish an opening from the bladder into the rectum. It was the first step in an operation which was to have included closure of the open bladder by some sort of plastic repair. The wall of the rectum and the adjacent bladder wall, bearing the ureteral orifices, were both pierced by a needle, carrying a thread to which a skein consisting of numerous threads was attached. This "wick" was left in place by the withdrawal of the needle, and it was hoped that the outpourings of both ureters would pass down by it to the rectum. Unfortunately the patient was carried off on the seventh day by peritonitis. The anomalous condition had extended to the placement of the peritoneum, which was found to have descended so much lower than the surgeon had any reason for expecting that the needle had been passed *through* instead of beneath it.

In reporting Lloyd's fatality, mention is made of a case then in the hands of Sir John Simon, which was "of an analogous description." Simon's operation was actually done before Lloyd's (July 5 of the same year) and was more nearly a genuine anastomosis, even though the fistula idea was still followed out. "Instru-

ments of a very ingenious construction were contrived" for Simon, by means of which he was able to pass threads from ureters to rectum. Traction upon these threads induced pressure necrosis and eventually uretero rectal fistulae. Some twenty days later most of the urine was flowing into the rectum and in the course of three months the operator sought to close up the natural ureteral openings and protect the exposed bladder. His efforts were not crowned with success; the patient went down hill steadily and died "of exhaustion" in about a year. Autopsy showed great disorganization of the urinary apparatus due to "suppurative inflammation." In view of the conditions already existing, in all probability, before the operation was undertaken, and the state of urological knowledge at that period, the fact that the patient survived as long as he did certainly reflects no little credit on the attending surgeon.

The first actual transplantation of the ureters was done by Thomas Smith in 1878, though even here the fistula principle still prevailed. A left lumbar incision was made; the left ureter was located by the passage of a bougie cut off as low as possible, and carried into the descending colon through a small incision. A suture of fine carbolyzed catgut was passed through the bowel wall and the cellular tissue of the ureter, holding the anastomosis in place. The urine from the left ureter passed with the feces for six days, none passing through the "artificial anus." Thereafter the child developed fever, both urine and feces passed at the lumbar incision and there was abscess formation in the loin about the kidney. After a month the situation cleared up, the child improved in health and was "up about the ward." When a year had elapsed since the closing of the abscess fistula it was deemed wise to repeat the intervention on the right side, which Smith expected to find much easier, as the parts involved would be more accessible. There was, of course, no means of testing the condition of the left kidney.

The second operation was done; within fifty hours the child had died of uremia. Inflammation subsequent to surgical handling had inhibited the working of the right kidney, which, "very much enlarged," had been carrying on the work of both sides. Ascending infection had long before destroyed all the secreting tissue of the left kidney. Smith's conclusions were that anastomosis between the ureters and the bowel was perfectly feasible; that the lower intestine was perfectly tolerant of the presence of urine in its content; but ureteral transplantation would never be possible because any communication between ureter and bowel was, in itself, a fatal lesion.

Smith's pessimism did not permanently, at any rate, deter others from repeating the attempt. In 1891 Küster removed a carcinomatous bladder and transplanted both ureters into the rectum. The patient succumbed in five days to peritonitis and renal infection. In 1892 Chaput did two operations along similar lines. The first was upon a woman suffering from ureterovaginal fistula. The ureter was doubly sutured to the rectum, one set being stitched through the mucous membrane and the other through the serous coats. Peterson communicated with the French surgeon eight years after this operation was performed and found that the patient was in good health, though no details were obtained as to the actual condition of the kidney. No conclusions can be drawn from a unilateral case under these circumstances. Chaput's second patient was not so fortunate. Upon her he did a double implantation of the ureters into the colon and cecum, three months intervening between the two steps of the operation. From the first intervention the patient made a rapid recovery and appeared to be doing as well as might be expected in a subject of tubercular cystitis. She died within a few hours of the second operation, uremia supervening so rapidly as to leave little doubt of the cause of death, even though no autopsy was performed.

The year 1894 witnessed two attempts by Duplay and one by Rein to transplant the ureters to the bowel; all three ended fatally. Trendelenburg in 1895 removed one kidney and the bladder for tuberculosis of the urinary tract, transplanting the remaining ureter into the sigmoid. The patient so soon died of tuberculosis of other parts of the body that the outcome of the ureteral transplantation was left in doubt.

The year 1896 witnessed the most important contribution to the technic of ureteral transplantation made up to that time. This was the procedure designed and carried out by Karl Maydl, acting upon the conception that retaining the ureteral orifices intact would preserve their natural powers of preventing regurgitation, and thus do away with the ascending infection which had hitherto rendered successful transplantation into the rectum practically impossible. He therefore resected the entire trigone (exposed in the classical cases of ectopia vesicae) made an incision in the adjacent sigmoid, carried the section of bladder bearing the two ureteral orifices through this, and affixed it in place with sutures. This operation was first carried out June 19, 1892, but was not reported until some years later. The original patient was living in good health in 1899. Of 9 patients subsequently operated upon, 1 died of shock the next day. This was the only fatality. The remainder were all alive in 1899 and evincing no symptoms of renal disturbance.

Maydl's method rapidly attained popularity in Europe and was performed with no important modifications until 1905 when the English surgeon Moynihan used it with so radical a departure from the original plan that it was later known as the Maydl-Moynihan technic. Though the British surgeon's patient was a sufferer from exstrophy of the bladder, the case differed slightly in that extensive attempts to close the bladder wall had been made during the patient's childhood, and extensive cicatricial formations hin-

dered the work of transplanting the ureters. The bladder was dissected up and as much tissue as possible left about the ureteral orifices; the ureters were outlined by catheters and when the section of tissue about their openings had been dissected entirely free it was drawn up toward the umbilicus, exposing the rectum in the bottom of the wound. The peritoneum was carefully stripped up and a rent accidentally made in it hastily repaired. A  $3\frac{1}{2}$  inch incision made in the rectal wall was held open and:

Into this opening the bladder was placed, being turned upside down so that its former anterior surface became posterior, and its former lower end became the upper. The ureters instead of passing forward to the bladder pass backward, and the catheters passed into the rectum and out at the anus. The edge of the bladder and the cut edges of the rectum were now sutured together, by two stitches that were continuous, one taking the right side and the other the left.

Lembert sutures were used without including the mucous membrane. The catheters were left in for four days. Thereafter, the urine dribbled from the rectum, as the anal sphincter had been stretched to facilitate the operation. Control of the sphincter was gradually reestablished, and was perfect at the expiration of a month.

The ultimate result of Moynihan's modification is to make a cloaca resembling somewhat that found in early fetal life or in birds. The transplanted bladder forms a pouch which assists in holding back the urine and making it possible for the rectum to act as a reservoir for liquid as well as solid excretions.

Commenting upon Maydl's original procedure, Peterson describes it as a "uretero-trigono-intestinal anastomosis." In his thesis published six years after Maydl's first presentation of his work, Peterson includes a table of 36 cases operated on by this method, and remarks:

The mortality in the 36 operations is surprisingly low when it is considered that

it is a difficult major operation and that the list includes the first cases operated upon before the technique had been perfected. When we compare this mortality with the 33 per cent mortality accompanying ureteral implantation without the preservation of the ureteral orifices, we are forced to conclude that the explanation lies in the intrinsic dangers of the latter operation rather than to a lack of skill on the part of the operators. Without the vesical ureteral orifices 11 deaths in 33 cases from rapidly progressive renal infection; with the ureteral orifices intact, 5 deaths out of 36 cases; 2 at least not being due to infection . . . The 6 fistulae resulted, in some of the cases at least, from timidity on the part of the operator to trust to his suturings and to the employment of gauze drainage. They are all reported as eventually closing. The noting in 5 cases of gradually disappearing lumbar pains would suggest a possible renal infection from which the patient slowly recovered . . .

"The number of cases (10) living without signs of renal infection" after two years, is encouraging.

The method employed by Boari in the same year (1894) differed considerably from those previously used. But as the 2 cases (his own and that of Casati using his method) were both unilateral, no final judgment as to the value of his innovation could be made. By means of an anastomotic button the Italian surgeon united the left ureter with the descending colon, doing the operation extraperitoneally through a curved incision. The posterior parietal peritoneum was opened to secure the colon, but closure was made extraperitoneally. The patient was alive and well six months after operation, but no information as to the state of her kidney could be recorded. Casati's patient had advanced vesical tuberculosis. Implantation of the left ureter into the colon by the button method was done, with the intention of doing the right side later and removing the bladder entirely. The tubercular infection proved fatal in five weeks so the second step was never done. No autopsy was secured.

Another mechanical contrivance was a

hollow nickel tube with cone-shaped ends devised and used by Chalot in 1896. The rectal end was slightly larger than

to their lower portions. A large drainage tube was left in the rectum for a considerable period. The urine passed by this

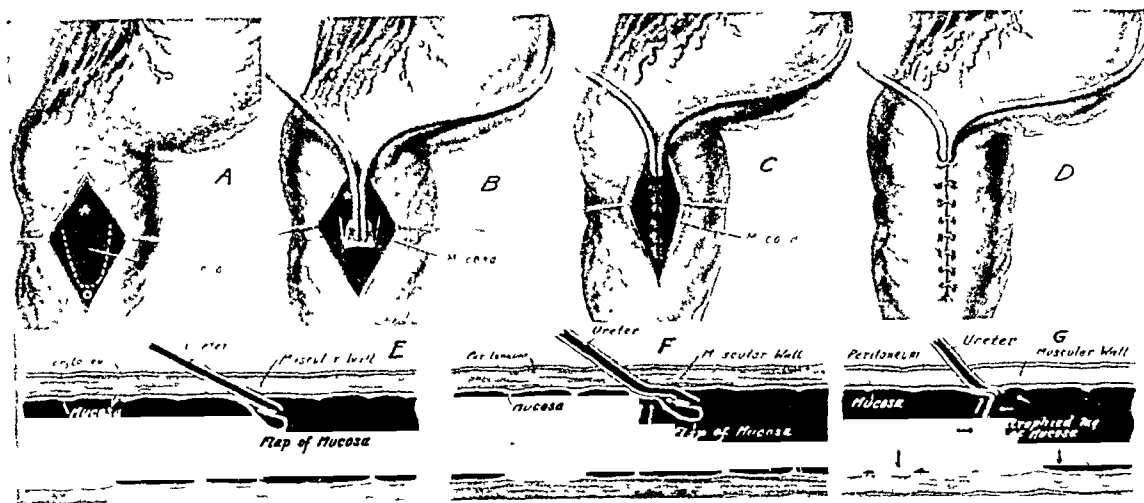


FIG. 1. Fowler operation. (After Coffey.)

A. Incision in rectal wall, including serous and muscular coats. Mucous membrane exposed in diamond-shaped area, and edges of incision retracted by thread retractors. Dotted line shows line of section of mucous membrane to form tongue-shaped flap.

B. Tongue-shaped flaps cut and turned back. Ureters are placed with their obliquely cut ends lying on surface of flap and secured in place by chromicized catgut sutures.

C. Flap-valve and ends of ureters placed in rectum, and row of chromicized catgut sutures closing gap in mucous membrane.

D. Showing longitudinal incision in bowel-wall closed by row of silk sutures. Ureters are shown passing into upper angle of closed incision.

E, F and G. Author's interpretation of Fowler technic. (A, B, C and D redrawn from Fowler's "A Treatise on Surgery.")

that designed to hold the ureter and provided with a hole through which a thread might be tied to assist in withdrawing the tube later, should this prove necessary. The smaller end was grooved so that it might hold a loop of thread thrown about it to hold the ureter in place after it had been slipped over the end of the tube. Chalot used this device in a case of uterine cancer involving the broad ligaments. He first isolated the left ureter, cut it off high up and joined it, by means of the button, to the rectum. He then ligated the internal iliac artery. The same manoeuvre was carried out on the right side, including ligation of the artery. Little hemorrhage accompanied the subsequent removal of uterus and adnexa. The bladder was not involved apparently, the reason for transplanting the ureters being that removal of the malignant area was impossible without irreparable injury

channel from the outset and no rise of temperature gave evidence of infection having taken place. For the first month the bowel evacuations occurred once or twice an hour and were diarrheal in character. Convalescence was otherwise uneventful. The report was made two months after the operation was performed. The patient was in excellent health, all wounds healed and urine passed per rectum only three or four times daily. No record can be found of the eventual fate of this patient.

In the United States a new plan was devised by George R. Fowler, who exposed the ureters by incising the posterior layer of peritoneum through a median abdominal incision. (See Fig. 1.) The ureters were then severed at their bladder extremities. The anterior wall of the rectum was incised through the serous and muscular coats, which were then retracted, leaving

a diamond-shaped area of mucous membrane. A tongue-shaped flap, having its base upward, was then cut in this space, doubled back and sutured to form a valve covered on both sides with mucous membrane. In the opening thus made through the entire wall of the rectum, the cut ends of the ureters were now drawn and sutured so that their obliquely severed ends lay upon the mucous membrane of the flap. The flap was then pushed into the rectum and the wall closed by catgut sutures. Fowler did this operation upon a boy of six years who had exstrophy of the bladder. In Peterson's monograph is quoted a statement from Fowler, made three and a half years afterward (the exact date of Fowler's intervention was September 20, 1896) to the effect that the boy was then in perfect health and had never given any indications of being affected with any urinary tract disturbance traceable to infection. Other operators who endeavored to imitate Fowler were not so fortunate. Three years later W. C. Wood reported the death of a patient from pyelonephritis, two months after he had been operated on by the Fowler method.

Several European cases were reported during the next three years, but all the successful ones prove on examination to have been unilateral (Tuffier and Schnitzler). In the attempts to do bilateral ureteral transplantations made by Tuffier and Du Jarnier (1896), Fritsch (1897), von Winiwarter (1898), and Schnitzler (1898) fatal renal infection occurred subsequently in each instance. Turetta's employment of Boari's button in a bilateral ureterorectal anastomosis in 1899 also terminated in a suppurative nephritis.

The publication of Peterson's thesis during the last year of the nineteenth century showed transplantation of the ureters to be a highly hazardous undertaking, only serviceable in the treatment of exstrophy of the bladder, and to be used for this solely in cases where the patient's condition was regarded as so desperate that death itself would be

preferable to continuance of life under the congenital condition. The few patients who had survived the operation for a long enough time to warrant the drawing of conclusions had undergone the procedure designed by Maydl: anastomosis of the trigone with the sigmoid or rectum, or that initiated by Berghem and variously attributed to Peters or Pozza: transplantation of each ureter separately, with a surrounding rosette of bladder wall, into the rectum.

A very careful consideration of the entire course of animal experimentation, beginning with that of Glück and Zeller in 1881, is included in Peterson's paper. The procedures followed by the different experimenters he divides into eight groups:

1. The severed ureter is inserted into the intestine through a small incision in the bowel wall and secured to the latter by sutures, which are passed through the intestinal serosa, and then either through the peritoneum removed with the ureter or its fibrous coats. (Glück and Zeller, Tuffier, Reed and Martin.)

2. A small incision is made through all the coats of the bowel and the ureteral and rectal mucosa sutured. The incision is then carefully closed about the ureter by Lembert sutures. (Morestin.)

3. A v-shaped flap is formed in the anterior intestinal wall, to which the ureters are sutured. This flap is buried by suturing over it the lateral folds of the bowel wall. (Vignoni.)

4. A rectangular flap containing the ureteral orifices is inserted into the bowel through an incision in its anterior wall. This flap is sutured to the freshened mucosa on the posterior wall of the bowel. (Pisani.)

5. A ligature with a needle at each end is passed through the end of the severed ureter. The needles are passed through a small slit made in the bowel wall and brought outside the intestine from  $\frac{1}{2}$  to 1 inch below. The two ends are made taut and the ureter is drawn into the bowel. The ureter is then secured in position by sutures. (Bardenhauser, Reed and Van Hook.)

6. The ureters are buried under the serosa and muscles of the intestinal wall and secured in place by sutures uniting

the ureter itself was subjected to a mini-

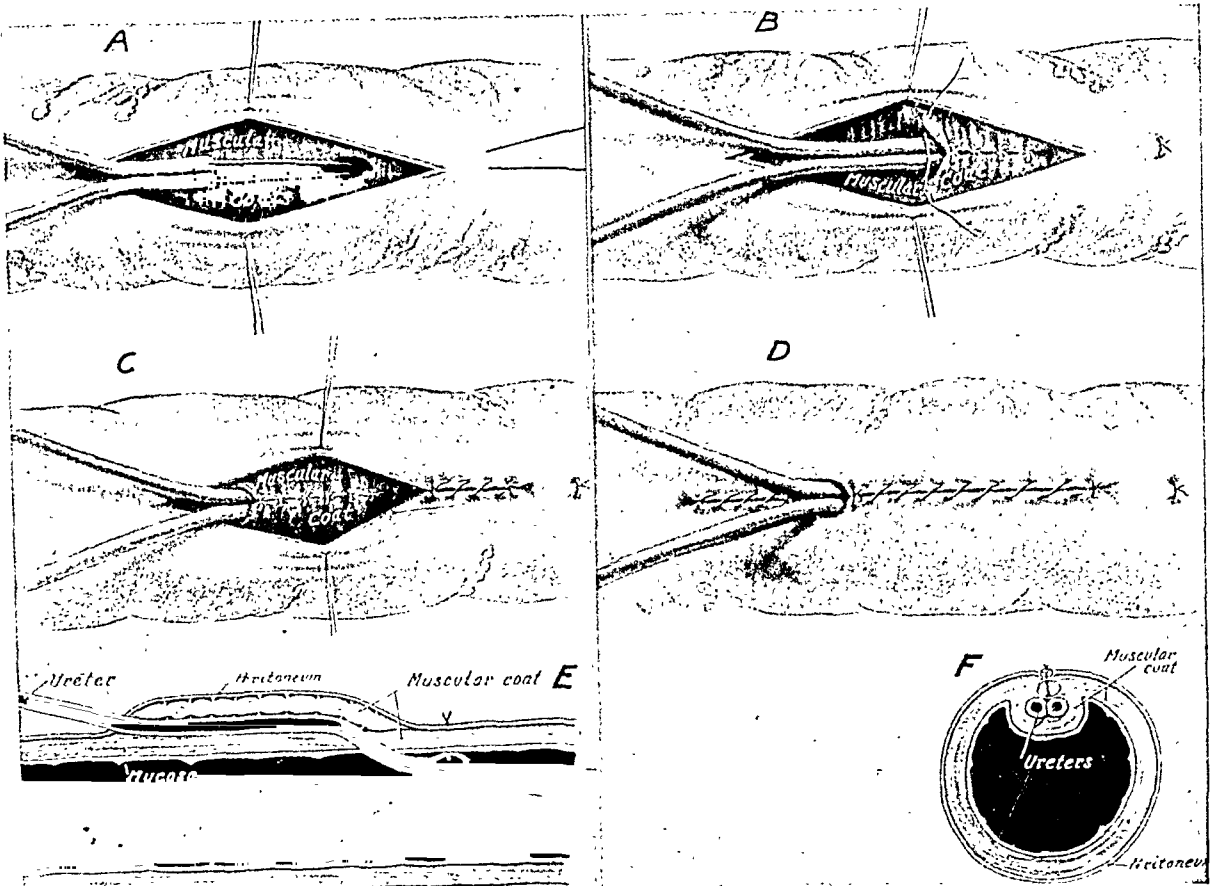


FIG. 2. Martin operation. (After Coffey.)

A. Intestine has been split down to muscular coat; stab wound made through muscular coat and mucosa near lower angle, two ureters being drawn into lumen of intestine.

B. Ureters have been anchored to inside of intestine by anchor suture; muscle wall being enfolded around ureter.

C. Muscular wall has been made to envelop ureters most of length of wound, peritoneum being closed over other sutures.

D. Completed operation.

E and F. Sectional views of completed Martin operation made to harmonize with his description in text. Ureters are surrounded by muscle wall.

the ureteral and intestinal mucosa, or drawn into the bowel, as described under Method 5. The muscular and serosal flap is then sutured over the ureters. (Krynski and Martin.)

7. The ureters are secured to a mucosal flap valve and buried obliquely under the serosa and muscularis. (Duval and Tesson.)

8. The anastomosis of the ureter and intestine is made with a mechanical device, which, after union is secured, passes into the intestine. (Boari.)

In all types of work the primary mor-

num of suturing gave the best results. The most important experimental work done in this country had been that of Martin, the results of which were published in 1899. As a gynecologist, Martin's interest lay in disposal of the ureters in cases where extensive surgical removal of the female pelvic organs had been undertaken, whereas practically all the work done by others had the treatment of exstrophy of the bladder as its aim. Martin states the idea underlying his experiments as follows:

1. The ureters should empty into the bowel in the direction of its long diameter from above downward, so that the urine shall be discharged in the direction of the fecal current. (See Fig. 2).

2. The ureters are buried in the walls of the rectum for a distance of an inch or more, longitudinally, so that in the act of defecation, the fecal mass will close the caliber of the ureters by its pressure on the mucous membrane, and that pressure is exerted from above downward in the direction of the onward flow of the urine, thereby emptying the ureter by a milking process. (See Fig. 2.)

3. The ureters are further protected by the muscular coat of the intestine. This is accomplished by surrounding them in their longitudinal course through the intestine to the extent of 2 cm. by the muscular coat of the bowel. This muscular coat of the bowel in acting from above downward milks the urine downward and holds the ureter closed when the rectum is aiding in defecation. When the contraction and closure due to defecation is over, the urine will spurt forth with considerable force, acting as a cleanser to the ureters.

Martin operated 4 human cases. In 3, death followed almost immediately, but as the condition of the patients was desperate before the intervention was undertaken the fatal outcome could not be justly attributed to the ureteral transplantation. In a case of exstrophy of the bladder only one side was done. Martin's experimental work appears to have been the most extensive, as well as the most thorough, of any of which I have found records up to the year 1910. The fact that he finally abandoned the attempt to find a clinically satisfactory method of transplanting the ureters is the most unfavorable comment possible upon the possibilities and probabilities which the subject held out. When he gave up animal experimentation, he stated that he was convinced that work along these lines would never be crowned with success.

The care of an animal cannot be such that one can minimize, as in the human, several sources of danger of infection. Gravity, as it is exerted on the urine in the ureters in the upright human, is lacking in the horizontal animal. The rectum of the human patient can be rendered and maintained relatively clean. The usual location of the implantation in the animal . . . makes the mouths of the ureters the most dependent portion of the bowel . . . much more subject to infection. The human . . . patient can be so controlled that ureteral catheters can drain the ureter for several days after operation and the mouths of the ureters [be] protected entirely from infected material, thus giving a start and an immunity when the resistance of the tissues [is at its lowest].

It is to be regretted that no human case ever came into Martin's hands wherein he might have had a fair opportunity to demonstrate the truth of these assumptions.

#### BERGENHEM'S PROCEDURE

Although Peterson lists in his bibliography the operated case reported by Bergenhem of Nyköpings, Sweden, in 1894, no other mention of this procedure is made in his monograph. This came out November 30, some months later than the two publications made by Maydl in the same year. It is emphasized by Buchanan that Bergenhem's procedure was *the first extraperitoneal implantation of the intact ureters, with rosette of bladder attached, by separate openings into the rectum*. The patient upon whom the operation was carried out presented an adenoma having its origin in an ectopic bladder. This growth was first removed. A month later all the bladder wall was excised with the exception of two small oval sections which were allowed to remain about each ureteral orifice. It was the operator's intent to work entirely outside the peritoneum. Unfortunately it was twice accidentally opened, but these wounds were immediately sutured. After the ureters had been freed by blunt dissection, the rectum was exposed by a transverse incision in the perineum. Two small anterolateral incisions were made in the

rectum, and through these the sections of bladder wall, carrying with them the ureteral orifices, were drawn and fixed

himself carried out a practically identical procedure. He failed to make any explanation as to why he waited so many years

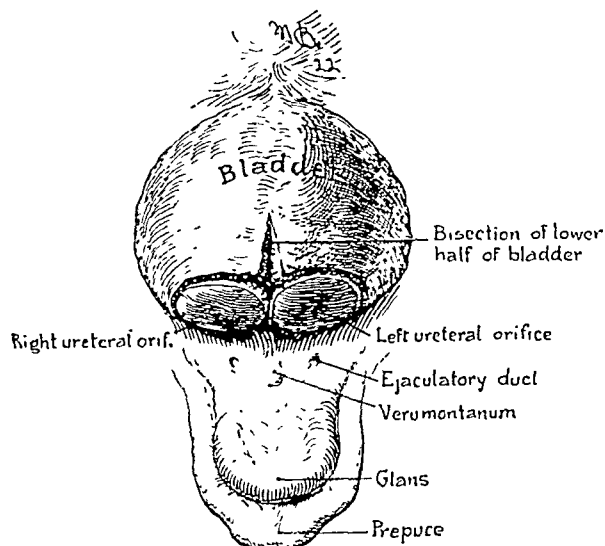


FIG. 3. Herniated rudimentary. Circular incisions showing section of bladder mucosa with ureteral orifices in center. Line of incision by which base of bladder was bisected. (After Hutchins and Hutchins.)

in position, using but one stitch for each ureter. (See Figs. 3-7.)

It was reported by Jaja of Florence, Italy, in 1901, that seven years prior to

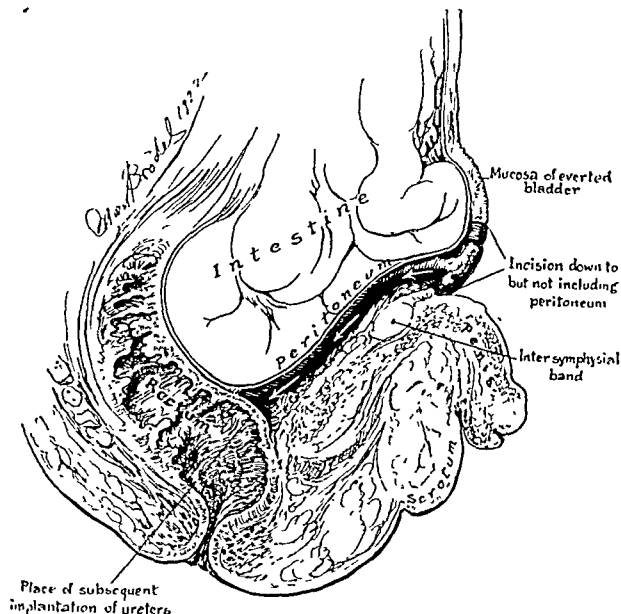


FIG. 4. Dissection of ureter and pushing back of peritoneum. Line of dissection showing peritoneum and exposing anterior wall of rectum and intersymphysal band. (After Hutchins and Hutchins.)

before publishing his work, and the description given of his technic is so vague that

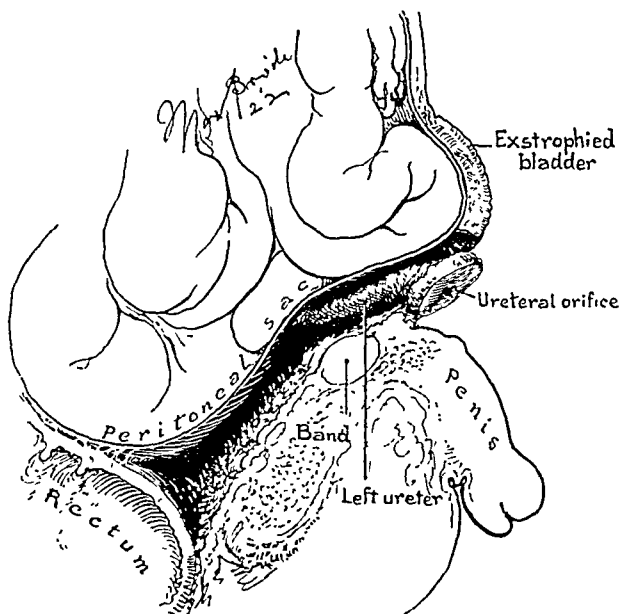


FIG. 5. Dissected ureter being adjusted. (After Hutchins and Hutchins.)

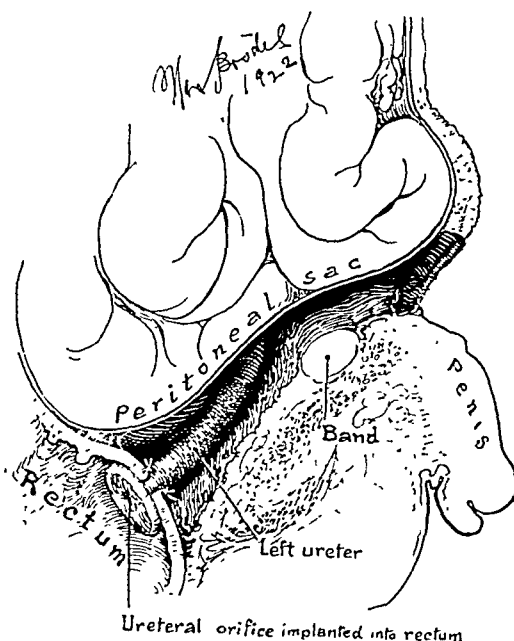


FIG. 6. Ureter inserted into slit into rectum and sutured in place. (After Hutchins and Hutchins.)

making this report, that is, on May 13, 1894, six months before Berghem published his case, the Italian surgeon had

it casts some doubt upon its exact nature. The honor of originating the idea of transplanting the ureteral orifices intact



into the bowel must, therefore, be accorded to Bergenhem. Following the Swedish author's publication the operation was

the first transplantation effected by an extraperitoneal route." His case was a very remarkable one in many respects,

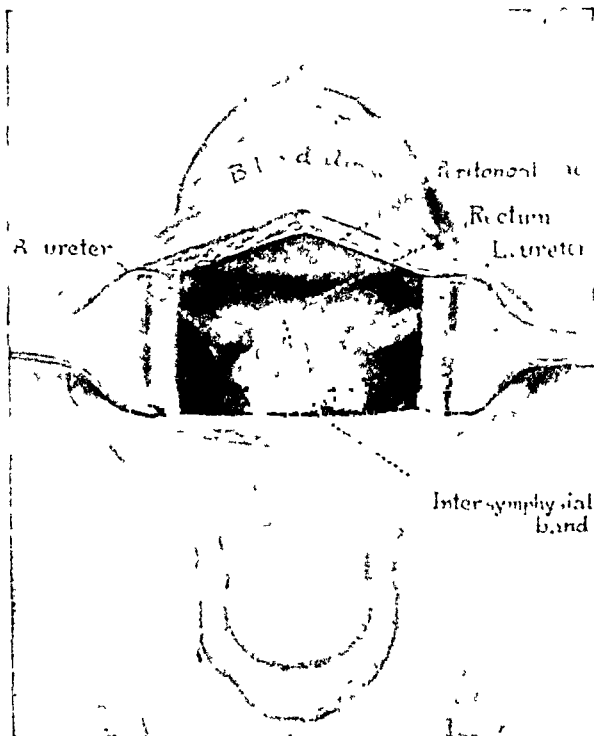


FIG. 7. Bisected bladder and intersymphysial band. Transplanted ureters in place with bulging peritoneal overlying sac. (After Hutchins and Hutchins.)

done by Pozza (Italy) in March 1897; by Franklin H. Martin (United States) in 1898, as a two-stage procedure; by Capello (Italy) in the same year; by London (Australia) May 12, 1899, and by George A. Peters (Canada) on the fifth of the following July. Probably because the periodical, *Eira*, in which the operation was originally described, was practically unknown to English-speaking medical men, Peter's name has remained attached to it in this country and England, while in Italy it is called Pozza's operation. It is evident, nevertheless, that Bergenhem was its originator, his work having preceded Pozza's by two and a half years, and that of Peters by almost five years.

Peters apparently knew nothing of the work previously done by Bergenhem. In the account which he published in the *British Medical Journal*, June 22, 1901 he says: "The operation . . . is, I believe,

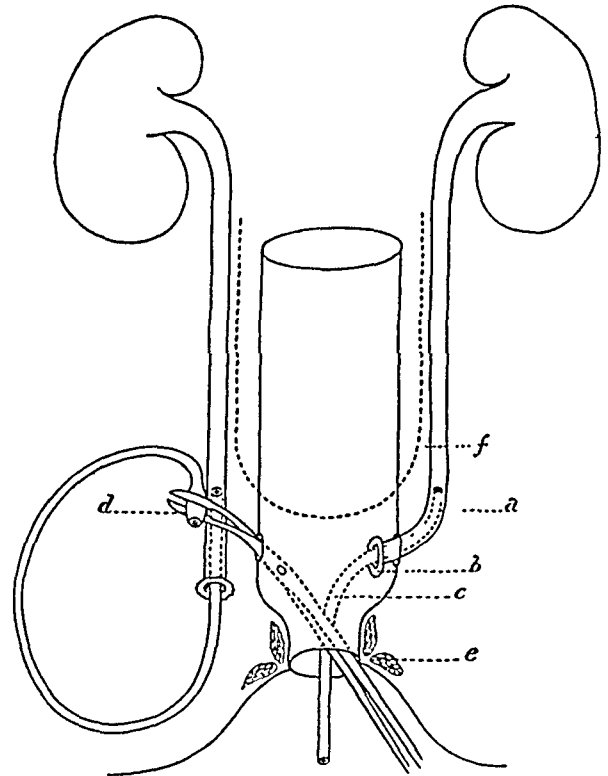


FIG. 8. Peter's operation. Scheme of transplantation of ureters into rectum by extraperitoneal method. Ureter (a) in transplanted position with (b) rosette of bladder mucous membrane and muscle; (c) catheter stitches into ureter by suture at (b) and protruding through (e) anus; (d) forceps passed by anus through opening in bowel and grasping catheter; (f) reflection of peritoneum. (After Coffey.)

as the patient suffered not only from congenital exstrophy of the bladder but had developed a severe procidentia recti, due to absence of the pubic arch. The rectal condition was first successfully remedied, and not quite three years later Peters undertook to establish urinary continence by transplanting the ureters into the bowel. The technic employed was practically the same as Bergenhem's, but Peter's criteria of selection for the site of implantation upon the intestinal wall are worthy of notice. The requisite qualifications are:

- (1) It must be above the internal sphincter;
- (2) It must be in the lateral and not in the anterior wall, so as to avoid kinking. (See Fig. 8.) (This actually occurred in the first

instance in Peters' case, necessitating a subsequent adjustment of the implantation.) (3) It must be high enough to permit the ureter to project slightly ( $\frac{1}{4}$  to  $\frac{1}{2}$  inch) into the lumen of the bowel without stretching. If the ureter thus projects it will form a papilla, which, when pressed up from within the bowel, becomes converted into a valve, similar to that at the entrance to the bile duct and the salivary ducts.

He made no attempt to stitch the ureters in place, deeming the precaution unnecessary. The catheters were left in place until they "came away of themselves," which happened in about sixty hours.

A year and a half after operation the boy was in perfect health. "There has never been the slightest tendency to a return of the prolapse . . . no evidence whatever of a disturbance in the function of the kidneys. On examination *per rectum* the mouth of each ureter can be felt as a salient papilla as large as the tip of one's little finger." The child frequently held the urine all night, and the daytime intervals of urinary evacuation were normal for his age and condition.

This report attracted wide attention both in North America and Europe. In the ensuing decade a respectable total of cases were reported as having been performed by "Peters' method."

#### THE FIRST DECADE OF THE TWENTIETH CENTURY

The technic of Maydl being much more widely known than that of Bergenheim, practically all the attempts made to transplant the ureters during the first ten years of the twentieth century were performed in accordance with this method. As early as 1903 Orlow, a Russian writing in French, was able to collect and tabulate 61 cases of exstrophy of the bladder which had been operated upon by Maydl's method of ureteral transplantation. In 7 of these cases the operators had varied considerably from the technic originally outlined by Maydl. The others followed his directions exactly, or with unimportant

modifications. Among those where the technic was considerably varied are to be found the procedures of Bergenheim, Capello and Pozza, showing that Orlow regarded Bergenheim's method as being merely a modification of Maydl's.

Omitting these 3 cases, Orlow's researches show that 13 patients died almost at once, 2 succumbing to a previously existing pyelonephritis. The immediate mortality was, therefore, 17 per cent. Five deaths were due to peritonitis; 2 to pneumonia, 1 of them being complicated by a metastatic parotitis; 2 to the effects of prolonged narcosis, and in 2 the direct reason for the rapid fatality was not given. It may be remarked that none of these deaths was caused by the ureteral transplantation *per se*; similar fatalities may follow any prolonged and difficult major operation. However, in one of Orlow's own cases he attributed the fatal outcome to his having put in but one layer of sutures; in Eiselberg's case, the sutures pulled away because of too great tension upon the trigonal implant; Bucheri included a ureter in his suture—all faults of technic.

Summing up the functional results in the cases surviving, it was found that on the average the patients were able to make the sphincter and retain the urine during the day, so that micturition was practically normal, and many of them were continent during the night also, although most of them were obliged to rise at least once. The operation thus should be adjudged successful in abolishing urinary incontinence. Estimate of the more remote results is rendered rather difficult by the fact that many of the patients were not followed for more than a short period, if at all. Yet some were under observation for three years or more. Six cases of pyelonephritis causing death eventually were found among the 45 patients surviving the operation, that is  $12\frac{1}{2}$  per cent. But these cannot positively be charged to the effects of ureteral transplantation, inasmuch as it is well

known that ectopia vesicae unoperated is prone to develop kidney infection.

#### EARLY VARIATIONS OF MAYDL'S TECHNIC

Graubner introduced sounds into the ureters and dissected them out with a portion of the bladder wall surrounding their orifices. A transverse incision, 4 cm. in length, was made in the sigmoid, and the ureters separately sutured into this incision with two layers of stitches. Mukulicz made use of the rectum instead of the sigmoid as a site for the transplantation of a section of bladder wall bearing both ureters. The results were poor; the patient was obliged to wear a urinal, and died within four months of pyelonephritis. Malinowsky first laid his patient face downward and exposed the rectum by the lumbar route; he was then turned over and all of the exstrophied bladder cut away, leaving the ureters attached to it. The peritoneum was not opened. The patient was thereafter turned once more upon his face, an incision made in the exposed rectum, the cellular tissue stripped from its surface, the freed bladder drawn toward the anterior wall the of intestine and sutured to the rectal incision. The patient died in six days. The object sought in so much altering of the patient's position upon the table was to avoid opening the peritoneum. Orlow, to whom I am indebted for the account of this Russian case, remarks that the procedure is "too complicated to permit many to become adept [in its performance]."

#### ANIMAL EXPERIMENTATION

In the first year of the century Jacob Frank of Chicago undertook some animal experiments upon direct implantation. Ten dogs were subjected to the following technic: The selected section of bowel was isolated; the peritoneal coat incised for a space of about  $\frac{3}{4}$  inch, and the peritoneum loosened up and retracted; a  $\frac{3}{4}$  inch incision was made in the remaining coats of the bowel. The cystic ends of the ureters were now severed and held

together by a silk suture. A needle armed with fine silk was passed from without inward, through all the coats of the intestine except the peritoneal, about  $\frac{1}{4}$  inch below the lower angle of the incision, then emerging through the opening. The needle was passed through the cut ends of the ureters and out through the intestinal wall, the same distance from the incision that it entered. The ureters were then grasped in the loop of silk and the ends tied tightly together, drawing the ureters into position and holding them there permanently. The intestinal wound of muscularis and mucosa was sutured transversely, compression of the ureters being carefully avoided. The peritoneum was then closed. The sutures in the bowel being thus covered by peritoneum, infection is obviated.

In his comments Frank stated that "the technic is all that can be wished for," but he declared simultaneous bilateral transplantation to be impossible in human beings. His optimism is somewhat hard to comprehend in that all his dogs simultaneously transplanted, 4 in number, died immediately. Those whose ureters were transplanted one at a time survived longer, but all eventually succumbed. While his technic quite possibly "obviated" immediate surgical infection, it did nothing to solve the problem of preventing infection ascending from the bowel to the kidney.

Another method, demonstrated experimentally upon dogs, was that offered by W. Howard Barber of New York in 1915. All Barber's 8 dogs survived operation, 1 dying within a week from sloughing of the ureter due to overextension. He argued that the ureter is necessarily traumatized and reduced in its motor efficiency, and resistance is unavoidably piled up at its extreme caudad end. The problem, then, is so to reduce this terminal work as to render the already impaired ureter physiologically capable of meeting it. For this purpose he offered the following technic: A mesoventrad

incision 5 cm. long is made in the lower abdomen; the ureter is identified and freed from its bed, and divided between two ligatures, just cephalad to the bladder. A straight cutting needle is attached to the cephalad ligature and made to penetrate the sigmoid colon in a line perpendicular to its long axis. Driving the needle through at a point 90 degrees distant on the intestinal wall will draw the ureter through each wall. The sigmoid being suspended by the glass rod method, the ligated cephalad end of the ureter is allowed to protrude on to the skin where its ligature is affixed by a single suture. The wound is then closed about sigmoid and ureter. Six hours later the exposed ureter is incompletely cut and allowed to empty. It may be returned to the lumen of the intestine at any time thereafter, but it is well to retain it under control until its continued patency is assured. One or both ureters may be transplanted in this way within twenty minutes. I have failed to find any record of this experimental method having ever been clinically employed.

The year 1909 witnessed the revival of Bergenhem's technic by Buchanan of Pittsburg, and the first presentation by Coffey of the method which is now so well known under his name. Buchanan compared the mortality following Maydl's procedure with that which had attended to smaller series of cases operated upon by the method of separate implantation of the ureteral orifices. He concluded that the separate implantation of the ureters answer every purpose of trigonal implantation both with reference to the preservation of a blood supply and the guarding of the ureteral orifices against ascending infection. As of the 80 patients on record as operated by Maydl's method 23 had died (28.7 per cent), while of 26 to whom the Bergenhem technic was applied 3 only had died (11.5 per cent), Buchanan decided that the second method was to be preferred. The important point in any technic he considered to be the preven-

tion of ascending infection; the important factors in this prevention he listed as follows:

- (1) Each ureter should pass in a direct course, without kink or twist, to the point of entrance into the bowel;
- (2) there should be no injury by forceps, knife or needle, of or near the ostium, that could cause a cicatricial narrowing of the passage;
- (3) the intra-intestinal portion should keep its position without tension;
- (4) no injury should be done the ureter by retention sutures;
- (5) the ureteral catheter should be used as a guide in dissection through operation, but not as a conductor of urine afterward;
- (6) no dilatation of the sphincter ani should be practiced, a rubber tube to prevent distention being amply sufficient.

Finding that Bergenhem's procedure fulfilled these requirements better than any other within the range of his knowledge, Buchanan performed it first upon a ten-weeks-old-infant, and a year later upon a child of three years, both males afflicted with exstrophy of the bladder. At the exhibition of the second patient, the first was also shown, being in good health and able to hold his urine in the rectum for about four hours.

The method of ureteral transplantation devised by R. C. Coffey of Portland, Oregon, was first worked out in connection with implantation of the bile-duct into the intestine. Before the Section of Surgery of the American Medical Association in June, 1910 the first results of this experimenter's work were presented. The method (See Fig. 9) consisted of careful dissection of the ureter which was cut in two above a ligature, one end split and a linen suture passed through this split end so as to include about one-half of it. The suture was then tied and the loose ends threaded through two needles; the end of the duct was wrapped in gauze to await preparation of the intestine. An incision approximately an inch in length was then made through the peritoneal and submucous coats of the bowel of the selected spot, the mucous

membrane being allowed to "pout" through the incision. Five or six suture stitches pick up the peritoneal and sub-

the outside of the intestine. Tying of the intestinal sutures closes the opening in the peritoneum. To permit the ureter to slide easily into its new channel the mucous membrane must be loosened for perhaps  $\frac{3}{4}$  inch. The ureter must therefore be tacked to the peritoneum at its point of entrance by two or three fine sutures of linen or silk, care being taken to penetrate only the outer coat of the ureter. "Thus practically all the steps of the operation are completed before the intestinal mucosa is penetrated and no sutures penetrate the lumen of the ureter."

#### SUMMARY OF COFFEY'S EXPERIMENTS

Of 9 dogs in which physiologic implantation of the ureter into the large intestine was done, 5 recovered and were in good health one hundred sixty-nine days, eighty-one days, seventy-five days and seventy-two days after operation, when they were killed with chloroform. One dog died on the thirteenth day without discoverable cause, the implantation being found perfect; 3 dogs died of peritonitis. In no one of the 9 cases did ascending infection take place. Six dogs upon whom direct ureteral implantation was done, the technic and surgical precautions being the same, all died immediately save one, which survived for sixty-one days, but was found to have lost practically all the secreting portion of the affected kidney, though the ureter had remained patent at its point of entrance into the intestine.

#### MAYO'S TECHNIC

In a recently published article, Coffey has stated that it was nearly two years after the completion of these experiments before he had a chance to make clinical trial of the procedure upon a human patient. During this period Charles H. Mayo, who had heard and favorably commented upon the original presentation, applied Coffey's plan to several patients sent to the Mayo Clinic for relief of ectopia of the bladder. (See Figs. 10-16.) The exact technic employed was described by Mayo

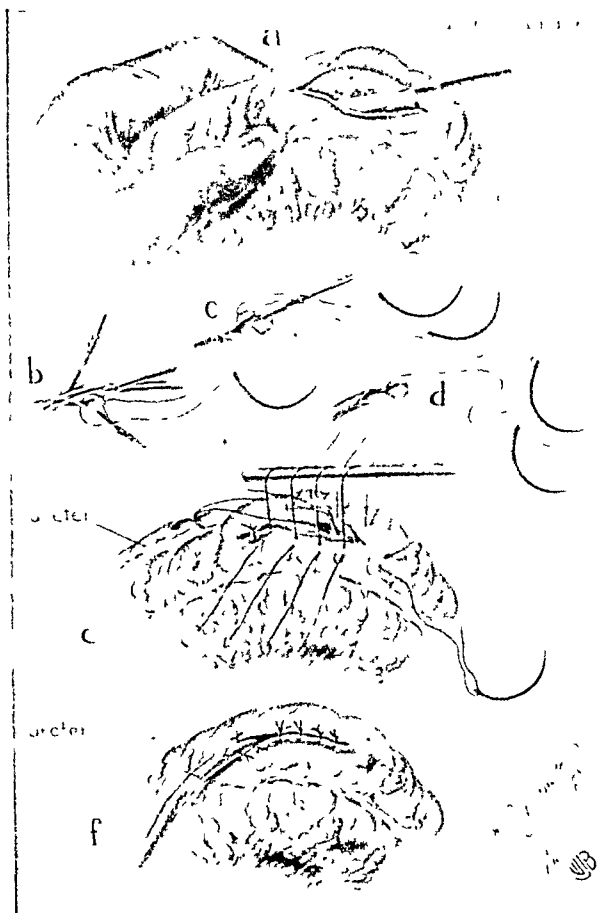


FIG. 9.

mucous coats at the edges of the incision, the suture at the upper end being tied as a control. The intermediate control sutures are lifted up on the flat handle of an instrument as they cross the incision, the intestine brought down close to the end of the split duct, the two needles carrying the traction sutures are passed beneath those holding the edges of the cut intestine, through a stab wound in the mucous membrane into the lumen of the intestine and then out again through the intestinal wall,  $\frac{3}{4}$  inch farther along the intestine. The points of the needles should emerge about  $\frac{1}{8}$  to  $\frac{1}{4}$  inch apart. Traction exerted on these two threads now draws the ureter into the lumen of the intestine where it is fixed by tying the threads of

in his contribution to the Osler Anniversary "Contributions to Medical and Biological Research," published in 1929, as follows: A lateral abdominal 4-inch incision is made, locating the ureter behind the peritoneum, in the pelvis. The peritoneum is then incised midway in the pelvis, this further exposure permitting 2 inches of the ureter to be dissected free. An inch from the bladder wall the ureter is divided between forceps, its lower end ligated, and closure of the peritoneum effected by running suture to the point of emergence of the ureter's proximal end. Judd, Mayo's colleague, modified this procedure slightly by making a lateral abdominal incision to the peritoneum, exposing and dividing the ureter extraperitoneally, opening the peritoneum at the point of its ureteral attachment, drawing out a fold of sigmoid to which the ureter was anastomosed outside the peritoneum, and finally replacing the bowel within the peritoneum over the incision to which it is sutured.

Right side anastomosis is made as low as possible. Opposite the isolated ureter a  $1\frac{1}{4}$  inch incision is made through the bowel's outer coats in the line of the longitudinal muscles, carried to, but not through, the mucous membrane. The tissues lateral to the incision are slightly separated, and a puncture made at the lower end large enough to receive the ureter, the lower end of which is split for  $\frac{1}{4}$  inch. A curved needle carrying No. 0 catgut is then passed through the tip of the ureter and tied, the short end of the thread being cut away. Passed through the opening into the intestine and emerging  $\frac{1}{2}$  inch below its point of entrance, the needle carries the thread, which when drawn upon, brings the ureter's end within the lumen of the intestine. Passing the needle through a fold of intestine at its point of emergence ties and fixes the ureter in its new location. It is further fixed by interrupted sutures used to approximate the divided peritoneum and muscle of the intestine, every other one of which catches a bit of its outer wall. At the upper

angle of the incision an adjacent fat tag serves to relieve ureteral pressure, being held in place by a stitch. Another row of

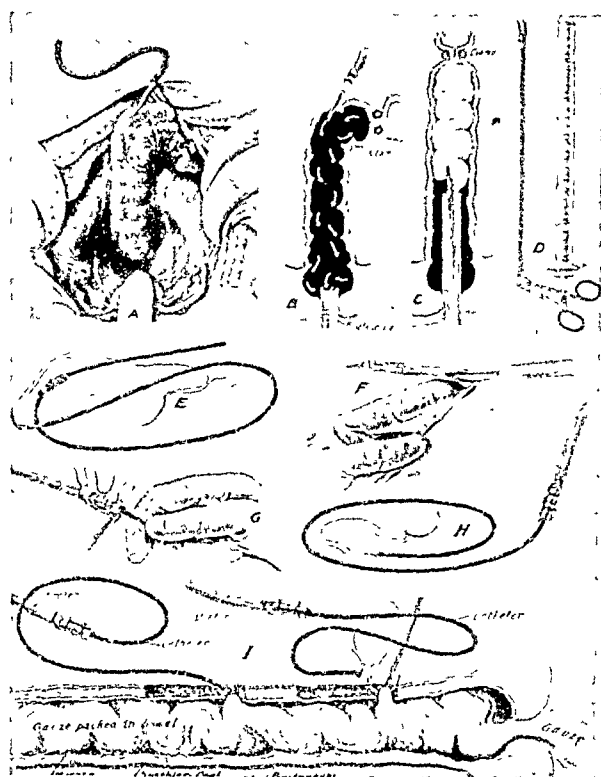


FIG. 10. Preparation of bowel and ureters.

- A. Bowel clamped, needle for washing inserted.
- B. Cross section showing washing out bowel.
- C. Packing bowel with gauze.
- D. Sigmoidoscope and laryngeal forceps used in packing gauze.
- E. No. 12 ureteral catheter, cuff of rubber tubing.
- F. Splitting ureter.
- G. Catheter inserted into ureter and tied in place by suture. (Note one suture is tied around ureter above cuff.)
- H. Catheter fastened in ureter.
- I. Packed bowel. Function of gauze in drawing ureters through wound. (After Coffey.)

continuous stitches over those first set in gives additional protection. And still other stitches adjust the bowel to the parietal peritoneum in such a way as to avoid kinking of the ureter and prevent traction upon it.

By this procedure the ureter is incorporated into the bowel wall in such a way as to be covered only by the mucous membrane for a distance of  $1\frac{1}{4}$  inch before it actually enters the lumen of the bowel. Thus any internal pressure will promptly close off the ureter. There has been estab-

lished a duct entrance similar to any other duct entrance elsewhere in the body, which is shut off by the pressure of

subsequent right-sided procedure exceedingly difficult, it has been found wise to make the first intervention upon the right.



FIG. 11. Ureters mobilized and severed. (After Coffey.)

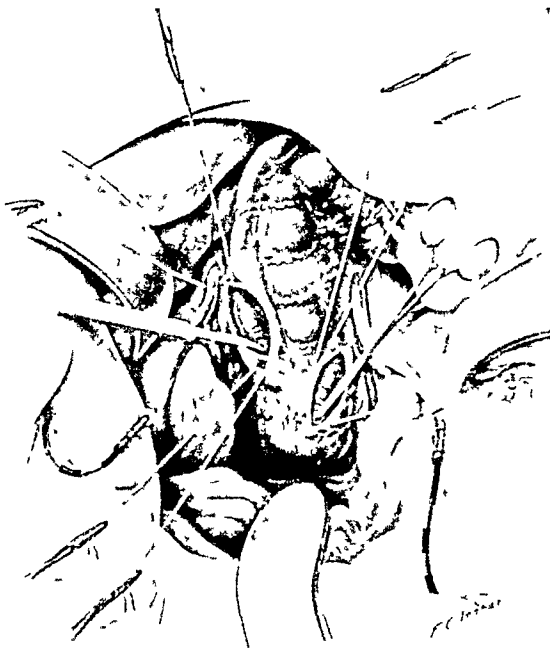


FIG. 12. Picking up gauze in stab wounds in mucosa. (After Coffey.)

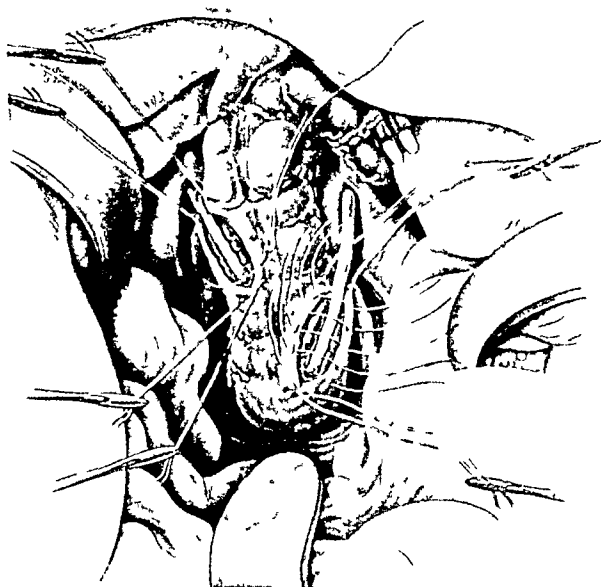


FIG. 13. Ureters being anchored in place. (After Coffey.)



FIG. 14. Completed operation without drainage. (After Coffey.)

ascending gases and liquids, but will open intermittently by normal ureteral peristalsis, just as it does when opening into the bladder. Because primary operation on the left side has a tendency to shorten the bowel, making a

Ten to fourteen days should be permitted to elapse between the first and second steps, as a certain amount of absorption of urine in the bowel will occur at first. This produces mild uremic symptoms, but

these will shortly disappear and in three or four days the urine will be found to be passing readily into the rectum, where

35 patients had been operated on at the Mayo Clinic for bladder exstrophy, a very large number considering the extreme

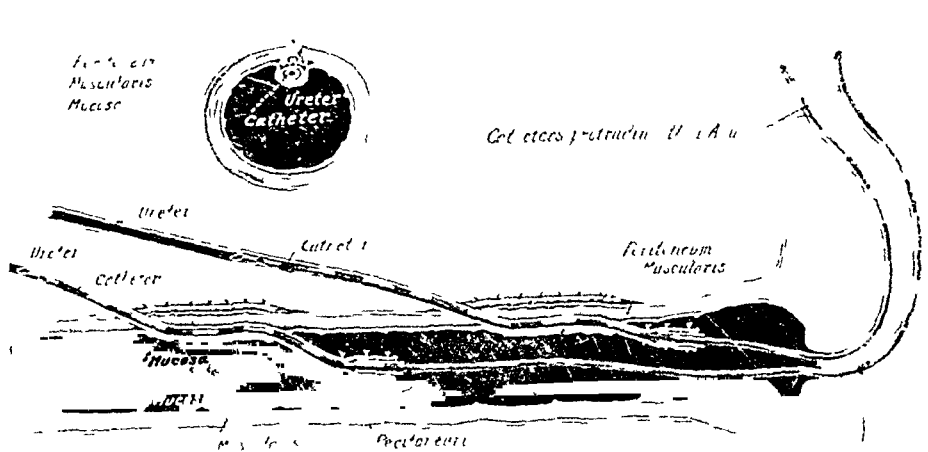


FIG. 15. Scheme of bilateral transplantation of ureters, tube technic. Sectional views. (After Coffey.)

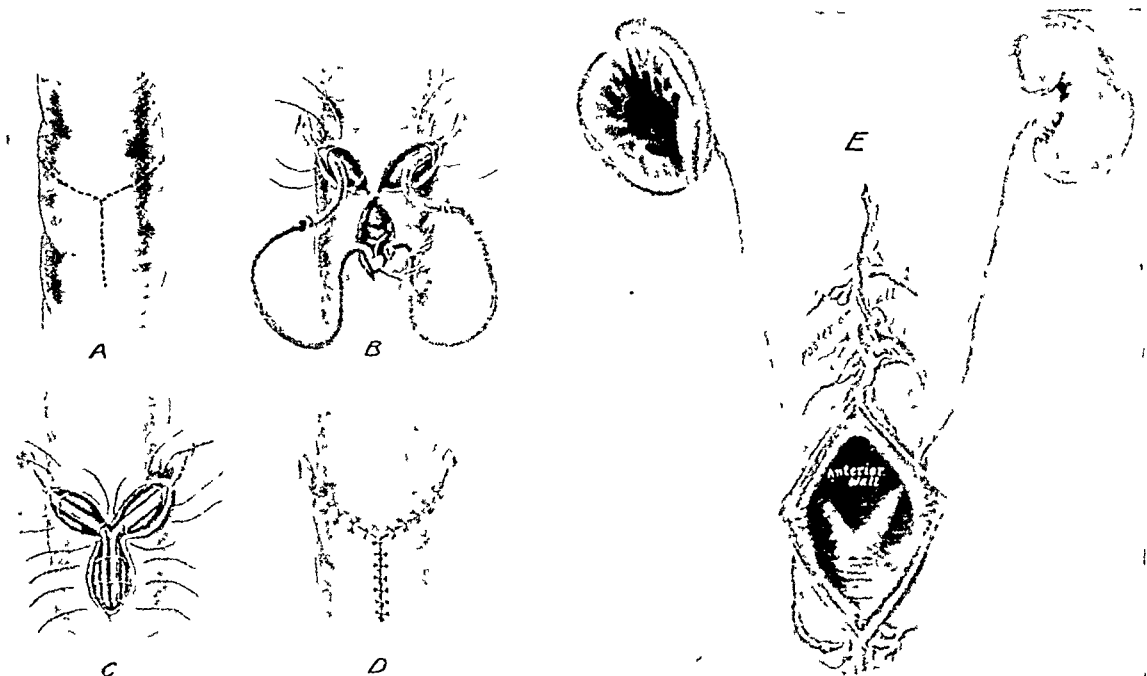


FIG. 16. Bilateral transplantation of ureters at same intestinal level.

- A. Dotted line shows line of two diagonal incisions emerging into longitudinal incision.
- B. Three incisions showing both tubes being attached to gauze through single stab wound.
- C. Technic of placing sutures.
- D. Completed suture line.
- E. Specimen removed from dog ten days after operation. (This operation has not been used on a human patient and is not recommended.) (After Coffey.)

it can be retained in most patients for the normal period between micturitions, two, four, or in adults, as long as eight hours.

At the end of the period covered in the article in the Osler Anniversary volume,

rarity of the anomaly. Six were treated by plastic repair; 3 operated upon by the Maydl-Moynihan method (2 dying of uremia); and 26 had had ureteral transplantation by the method just outlined. Four of these patients died shortly after



operation. Of the remaining 22 successful cases, there were 2 in which there was a solitary kidney.

Up to the time the first report was given out from the Mayo Clinic there had apparently been little general interest evinced by the medical profession in Coffey's plan of ureteral transplantation. The Maydl operation as modified by Moynihan was most commonly employed, though there is a fair sprinkling of articles concerning the use of "Peters," that is Bergenhem's, procedure in the literature published between 1905 and 1920. The Moorheads, describing 2 cases of bladder exstrophy treated by a modified technic, gathered together records of 152 cases previously so handled, and in two publications on the same theme, make no mention of Coffey or the advantages which his technic offers over the older methods. William E. Lower of Cleveland, writing in 1923, says it is his own opinion that "some technic which insures the application of the principle proposed by Coffey should be adopted." This principle he quotes from Coffey himself as consisting of "submucous implantation of the duct for the purpose of reversing the course of static intra-intestinal pressure and bringing it to bear on the site of the duct . . . The essential mechanical principle necessary to uniformly successful implantation of the ureter is that the ureter shall be made to run immediately under the loose mucous membrane for a distance, before entering the lumen of the intestine."

Certain details essential to success in using the Coffey method are mentioned by Lower as follows: Preliminary to operation, the function of the kidneys, as for any intervention upon ureters or bladder, should be checked up by blood chemistry and the standard tests of renal efficiency. The bowels should be well cleared out two days before operation and a rectal douche given on the operating day. Guthrie's advice in regard to the Trendelenburg position should be followed, the patient being placed in this posture before being anesthetized. Suction

of the diaphragm will thereafter aid in pulling the intestines out of the pelvis. All abdominal viscera should be held out of the pelvis by efficient gauze packing. Lower later discarded Coffey's intestinal clamp, which he found unnecessary if the bowels had been thoroughly cleared beforehand. The dangers of urinary absorption are lessened by leaving a tube in the rectum until that organ becomes accustomed to its new content, and the free employment of saline rectal douches.

At the time of writing Lower had done 16 transplantations, 10 of them being done according to Coffey's technic: 3 for vesical carcinoma and 13 for exstrophy. The ages of the patients varied from four months to fifty-four years. Only one patient was lost.

#### HINMAN'S WORK

At about this same period Frank Hinman of California, with other workers at the University of that State, undertook a series of experiments in transplanting the ureters into the duodenum. The reason for selecting this portion of the intestinal tract as the site of implantation was the freedom from infection, one of the main drawbacks to all procedures upon the lower bowel. The supposedly greater absorption of urine, were it diverted into the small intestine, had hitherto kept investigators from employing this site for implantation. The results of the experiments do not assist us in any way in solving the problem of ureteral transplantation for cases where the bladder is missing or defective, or under any conditions which call for bilateral diversion of the urinary output. All the experimental animals died within twelve days of the time when the entire urinary output was diverted to the duodenum, either by bilateral transplantation of the ureters, or by unilateral transplantation and opposite nephrectomy. Except for a severe diarrhea in the terminal stages, the symptoms presented were identical with those following bilateral nephrectomy, with most marked nitrogenous retention in the blood.

The technic devised by Coffey seems now to have supplanted all others to a very great extent, at least so far as this continent is concerned. Abroad, reports of cases, more or less successful, wherein Maydl's method had been used, still continue to appear. Several Canadian physicians have recently given accounts of the present condition of patients operated upon by Peters, who died in 1911. All 5 are living, 4 in excellent health. One is known to be suffering from vesical infection but is still able to work at a trade. The so-called Peters' operation is still popular in Great Britain and its dominions.

During the past two years Coffey has published several considerable modifications to his technic, and a number of operators have given us accounts of their experience in using both his original and revised methods. McKenna, in a paper read before the American Urological Association in 1927, remarked that a review of the literature shows that the results of ureteral transplantation have been good in the hands of comparatively few surgeons, and it would be a wise plan for those who have obtained good or even fair results to favor us with details, not so much of the technic they employed, the details of which "are sufficiently well known," as of the functional, bacteriological and pathological results of the operation. He then proceeded to give an account of animal experimentation carried out under his own supervision. Four of the 5 dogs first subjected to operation died. "Death was not due to the Coffey technic but to our own fault in carrying it out." Perfecting the technic by removing all tension from the ureter after transplantation, and introducing the end far enough into the bowel, which they had previously failed to do, did away with ascending infection, and permitted the dogs to live to complete convalescence, thus providing material for functional and bacteriological study.

Coffey has expressed himself several times as disappointed that his operation had not found a wider field of application.

Up practically to the present time, no one has undertaken ureteral transplantation to the bowel for any condition other than exstrophy of the bladder. He continued his experiments in the hope of making the operation safe enough to permit its use as an alternative in carcinoma of the bladder, and similar conditions. In 1925 he developed what he now calls "the tube method," recently described in the following words: Mobilize and sever the ureter; insert a small rubber tube well up into the dilated ureter; place a strong linen thread around ureter and tube in order to anchor the tube, to close the ureter against intestinal infection, and to strangulate the ureter so that the tube may be automatically removed later on. After opening the intestine in the usual way, the small tube is passed through a stab wound in the intestinal mucosa and attached to a rectal tube which has been passed up by way of the anus. Traction on the rectal tube will draw the ureter into the intestinal wound prepared for its reception. This accomplishes submucous implantation of the ureter in exactly the same way as if no rubber tube were inserted in it. Coffey remarks:

By the use of the tube to transmit the urine through the edematous tissues surrounding the anastomosis, the kidney functions just as if the ureter was brought out through a loin wound or through an abdominal wound. Therefore, it appeared that both ureters might be implanted simultaneously with the same degree of safety that accompanied the implantation of one ureter, and there seemed to be no good reason why, in certain cases at least, the bladder could not be removed and the ureters implanted, making a complete operation at one sitting.

This technic was employed by George Gilbert Smith in 10 cases of inoperable cancer of the bladder. He reports that though the procedure suggested by Coffey was of value, so far at any rate as the use of the indwelling tube was concerned, but he deprecated the idea of bringing both ureters through the same incision in the bowel wall, "inasmuch as this

method causes the right ureter to be strung across the pelvis like a clothes line, and invites intestinal strangulation." Smith found that dealing with otherwise healthy children, as in most cases of bladder exstrophy, is a fundamentally different proposition from dealing with the majority of sufferers from carcinoma of the bladder, i.e. elderly people, constitutionally much depleted, who have little physical reserve or resistance and upon whom wounds cannot be expected to heal readily. To remove the bladder and implant the ureters in the rectum, "which has to be done at one sitting if done at all," is a very extensive procedure under the best conditions, and will prove too great an ordeal for most subjects of bladder carcinoma.

#### SUMMARY OF HISTORICAL DATA

*Maydl.* Up to the work of Maydl transplantation of the ureters into the bowel had been uniformly unsuccessful. Maydl's technic was the first making any attempt to provide against regurgitation of the bowel content up the ureter. Its chief lack was the failure to guard in any way against direct contact of the ureteral orifices with the fecal current. This greatly enhanced the dangers of infection. Yet the idea of preserving and transplanting the ureteral orifices with their normal anatomical valves intact was a distinct advance over anything which had been done in the past.

*Bergenheim.* The contribution of Berghem consisted in transplanting each ureter separately, each with its normal valve intact; and more important still, in performing the operation extraperitoneally, which considerably lessened the immediate operative risk. Peters' technic does not vary from Berghem's in any essential particular.

*Fowler and Martin.* The method employed by Fowler followed the principles of the Maydl procedure; that of Martin those which underlay the work of Berghem. Both of these operators introduced

a new element by realizing the necessity of providing valve formation when the ureters were to be directly transplanted into the sigmoid. Martin was the first operator to advance the idea of suturing the ureter within the rectal wall. Both Fowler and Martin failed to realize the necessity of preventing direct contact of the ureter with the infected bowel content.

*Coffey.* The technic elaborated by Coffey is but a slight modification of that put forward by Martin. Martin embedded the ureter in the rectum adjacent to the mucosa, and sutured the rectal musculature directly over it. Coffey proceeded upon the conception that the passage of the fecal current would exert pressure upon the ureteral opening in the bowel wall, thus closing it against the downward passage of feces. This would produce a valvular effect which would minimize ascending infection. Yet, in common with those who preceded him, Coffey exposes the cut edge (that is, the ureteral orifice) to direct contact with the bowel content. Reviewing these various procedures, it appears to me that the chief cause of failure has been the lack of protection from fecal contact afforded to the tissues of the ureter itself.

Therefore, the greatest obstacles to be surmounted in the transplantation of the ureters are: (1) Direct contact of the end of the transplanted ureter with the feces; (2) the lack of a canal or passage which would assist in avoiding this contact; (3) the non-existence of any valve or structure exerting valvular action. The requirements of a satisfactory technic are therefore: *removal of the ureteral orifice as far as possible from direct contact with fecal material, and closure by pressure of any possible avenue of infection.* To meet these requirements I have devised the following technic:

#### AUTHOR'S TECHNIC

The animals used were dogs subjected to several days' starvation before operation. Also 1½ oz. of castor oil twenty-four hours before operating. A soft soap enema

was given at 8 A.M. and one immediately before operation.

Incision is in the midline, extending

are held by means of sponges wet in saline solution. This exposes the rectum, bladder and ureters (Plate 1, No. 2). The bladder

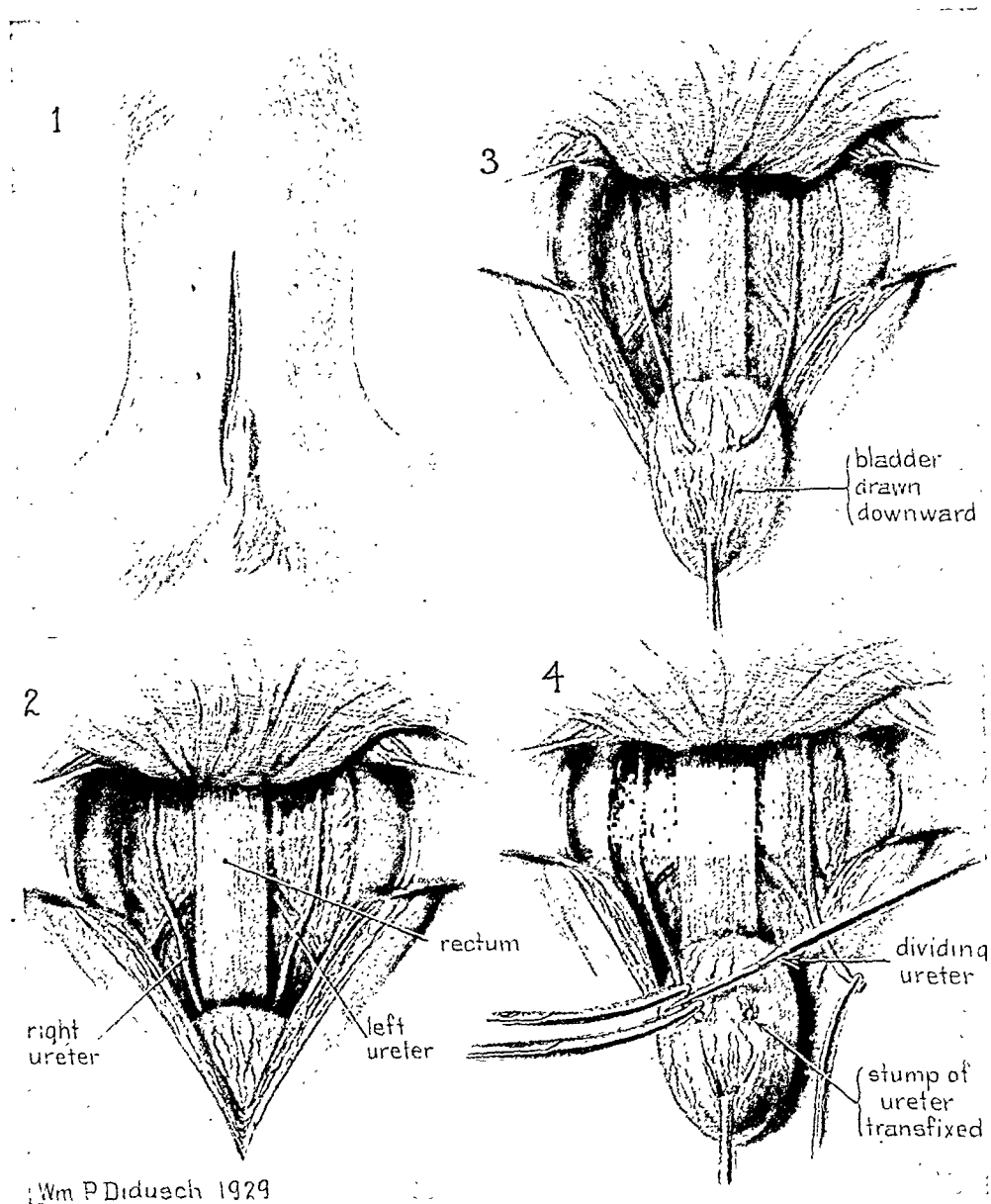


PLATE I. Author's method.

1. Incision is made in midline, through skin and fat; recti muscles separated by handle of scalpel.
2. Gauze pushes intestines upward, holding them out of operative field; rectum exposed; ureters can be seen passing downward to bladder, which is visible in lower angle of wound.
3. Bladder is drawn downward and outward; ureters can be seen at their point of entry into bladder wall.
4. Left ureter divided and stump transfixed; right ureter caught between two clamps in act of being divided.

about 6 inches from the pubis (Plate 1, No. 1), through skin, musculature and peritoneum. (In the human subject only skin and musculature should be incised, respecting the peritoneum.) A self-retaining retractor is inserted and all bleeding vessels clamped and ligated. The intestines

is now grasped by an Allis clamp and drawn outward and downward from the pelvic cavity, exposing the point of entrance of the ureters into the bladder wall (Plate 1, No. 3). The ureters are clamped close to the bladder, and a second clamp placed slightly above the first. In

placing this second clamp great care must be exercised not to traumatize the ureteral tissues. The ureter is divided between the

tion being sedulously avoided, and particular attention being directed to the preservation of the small artery which

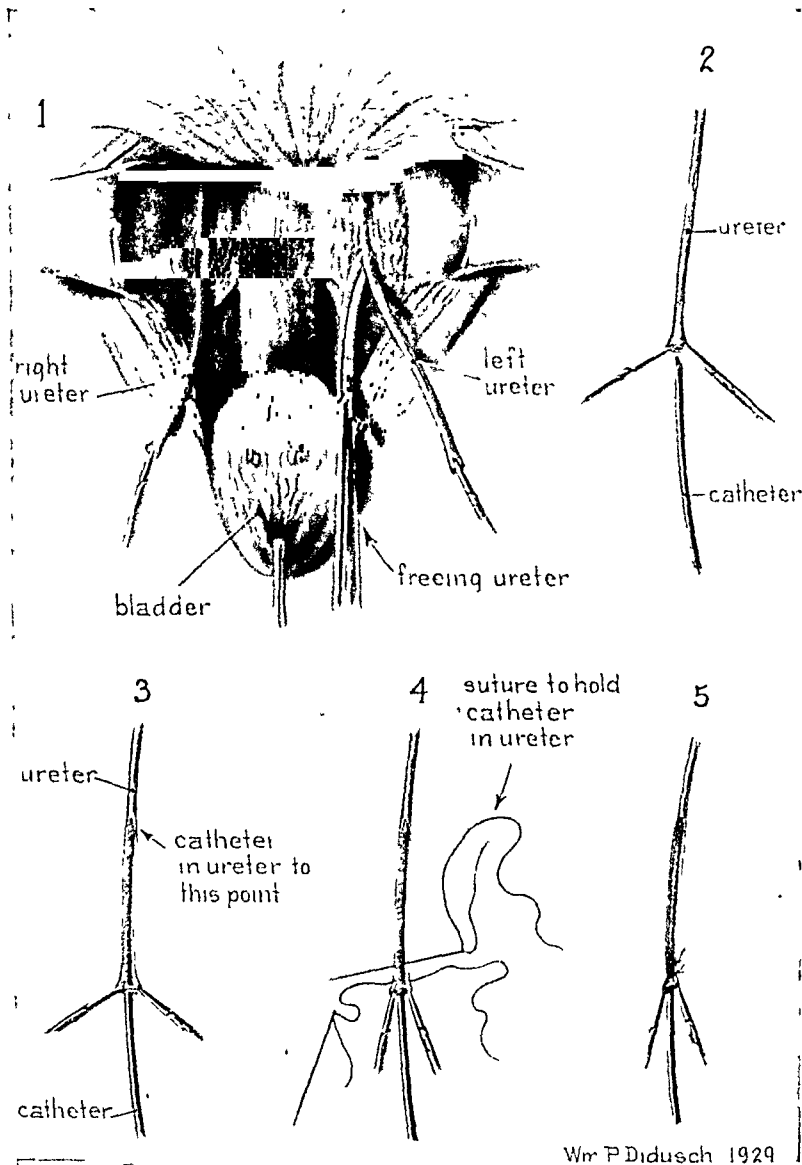


PLATE II. Author's method.

1. Ureters freed as high up as possible (for a distance of 8 or 9 cm.).
2. End of ureter held by two fine mosquito clamps; ureteral catheter about to be passed into open lumen of ureter.
3. Catheter passed into ureter for distance of about  $\frac{3}{4}$  inch.
4. Two sutures passed through fibrous coat of ureter.
5. Sutures tied to hold catheter firmly in place.

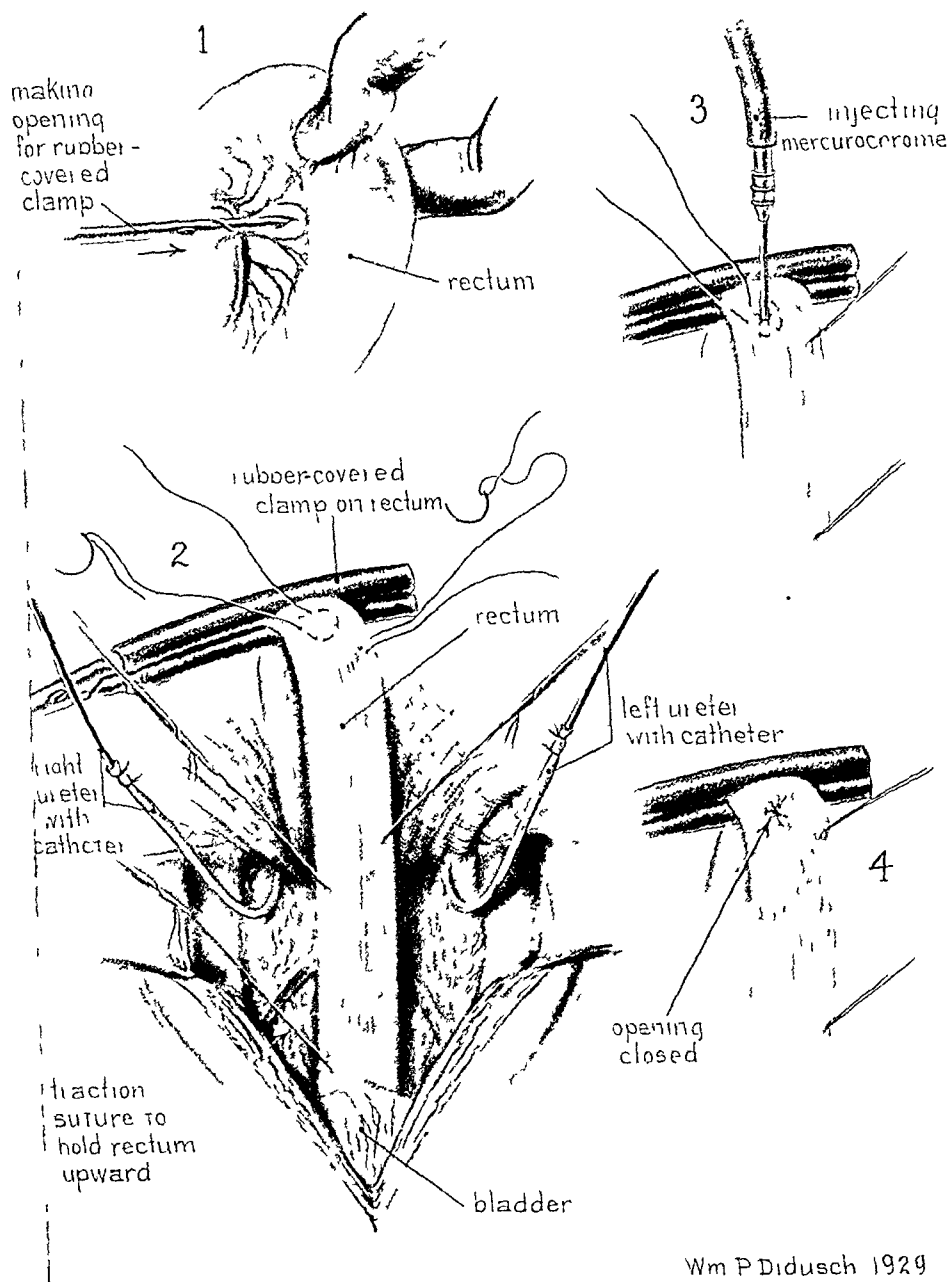
clamps, and the vesical stump ligated and transected by suture (Plate I, No. 4).

The second step in the procedure is the freeing of both ureters for a distance of 8 or 9 cm., almost to the renal pelves. This dissection should be carried out with the utmost care, all unnecessary manipula-

accompanies each ureter (Plate II, No. 1). When freed, the clamp upon the end of the ureter is replaced by two mosquito clamps which are placed very carefully so as to grasp only the thin fibrous coat, holding the lumen of the duct free and unobstructed (Plate II, No. 2). A No. 6 or No. 7

ureteral catheter is now inserted for a distance of about 5 cm. This insures a gradual curve in the direction taken by the

the catheter, as the insertion of a catheter even the slightest degree larger than the lumen will induce pressure upon the blood



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PLATE III. Author's method.

1. Hemostat being plunged through mesentery between two vessels, to make opening for reception of rubber-covered clamp about to be placed upon rectum.

2. Bladder returned to its position in abdominal cavity; stay-sutures have been placed on either side of rectum to act as landmarks for position of incision to be made for reception of ureters; rubber-covered clamp in position on rectum; purse-string suture set in below clamp, suture needle having been passed through serosal and muscular coats, but not mucosal lining of bowel.

3. Large-caliber needle attached to hyperdermoclysis outfit being plunged through area encircled by purse-string suture, for irrigation of rectum by mercurochrome solution.

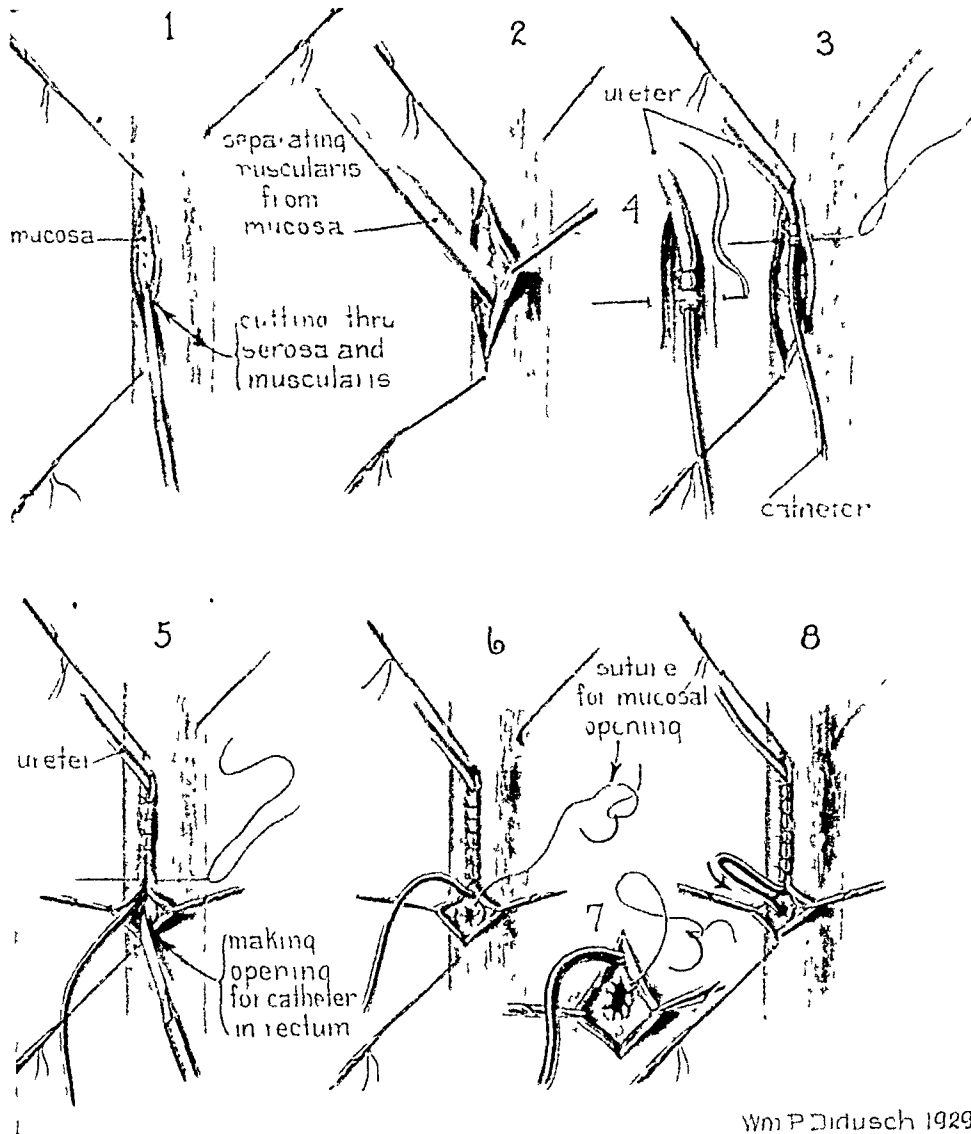
4. Closure of opening left by withdrawal of needle by drawing up purse-string suture.

ureter, and prevents any kinking (Plate II, No. 3). The exact dimensions of the ureter must be considered in selection of

vessels with inevitable necrosis and failure of the operation. A catheter of proper size being in place, it is held in that position by

three No. 000 chromic catgut sutures (Plate II, No. 4). It is important that these sutures transfix the ureteral tissue as

means of a syringe, but re-testing at this point is necessary, inasmuch as the epithelial layer of the ureteral wall sometimes



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PLATE IV. Author's method.

Technic of ureteral transplantation on right side; that on left side is carried out in same manner.

1. Making incision through serosa and muscularis down to mucosa of bowel wall. Incision is made lengthwise of rectum between two stay-sutures previously placed on right side.
2. Muscularis being separated from mucosa by means of scalpel handle.
3. and 4. Ureter, with inserted ureteral catheter, carried to upper angle of incision in rectal wall and fixed in position by stitches passed through fibrous coat of ureter but not through catheter.
5. Muscularis sutured over catheter to form tube; small opening made in rectal mucosa through which ureteral catheter will be passed.
6. and 7. Continuous suture run around entire circumference of mucosal orifice to insure permanent patency.
8. Ureteral catheter being passed through orifice in rectal mucosa into lumen of rectum.

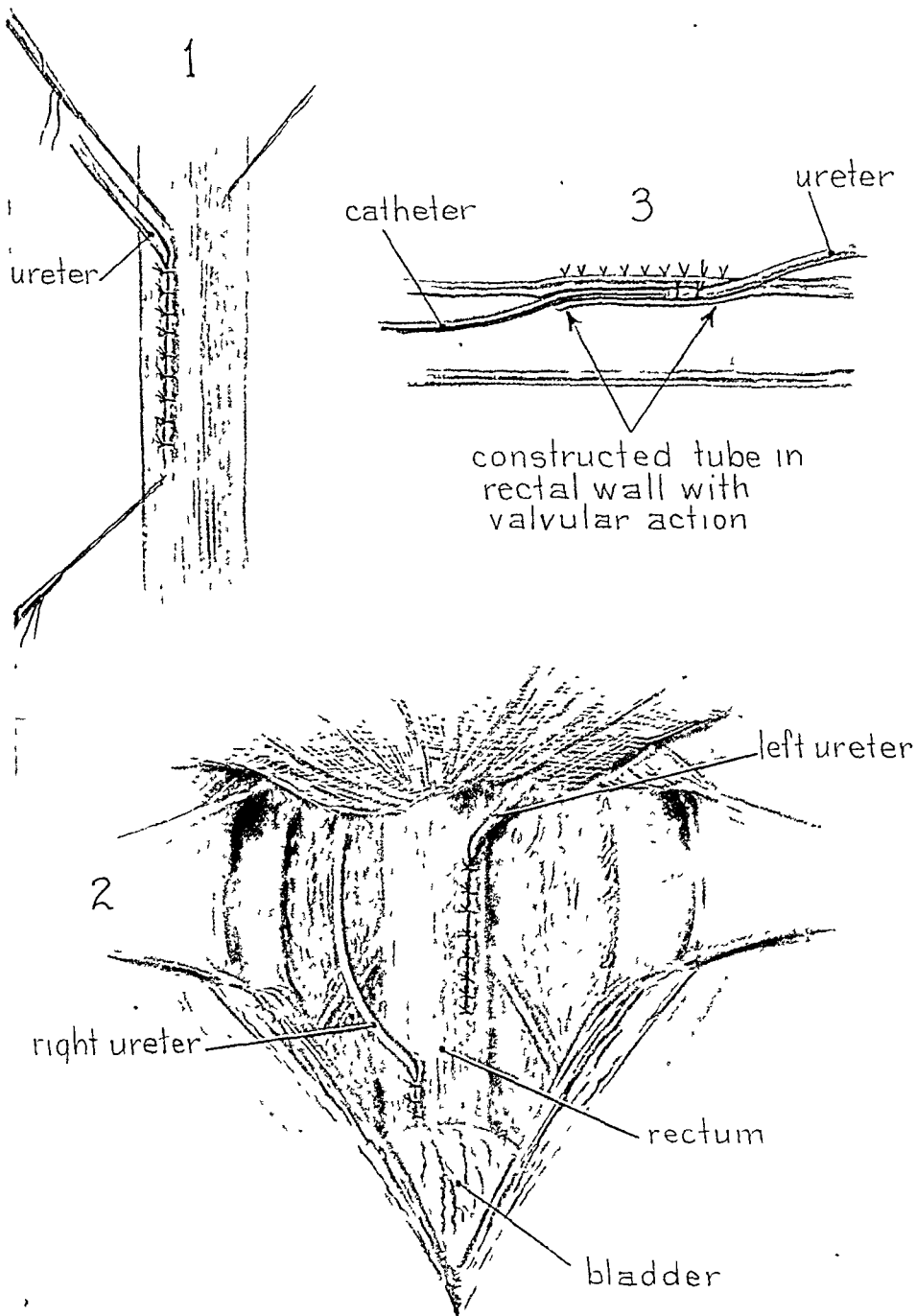
close to the cut end as it is possible to place them (Plate II, No. 5). Suturing accomplished, the catheter is tested to make sure that it is patent. It should, of course, have been previously tested by

buckles so much as to occlude the orifice. All the preceding manoeuvres are carried out alike for both sides.

In the third step of the procedure, attention is directed to the sigmoid.

This is drawn up into the wound until its mesenteric attachment is exposed. An area in the mesentary is now selected

mately 14 to 15 cm. from the anus. The hemostat is plunged through the mesenteric attachment, preparing the way for



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PLATE V. Author's Method.

1. Incision in rectal wall completely sutured, showing ureter entering at upper end.
2. Operation completed for both sides, ready for closure of abdominal incision. Rectum returned to normal position. Ureters can be seen entering rectum on either side.
3. Longitudinal section (semi-schematic) showing ureter with inserted ureteral catheter in position. After removal of catheter artificially constructed tube will act as valve when compressed by passage of fecal current.

where a hemostat can be passed between two vessels, the point chosen being approxi-

the applications of a rubber-covered clamp (Plate III, No. 1). This clamp shuts off the



rectum from the upper portion of the bowel but is sufficiently high up (14 to 15 cm. above the anus) to afford abundant room for the transplantation of the ureters. After placing the clamp, a purse-string suture is set in upon the outward curve of the bowel wall, the needle being passed through but two of its coats, that is, *down to, but not through* the mucosa (Plate III, No. 2). A large-caliber needle connected with a one-quart hyperdermoclysis outfit, is now thrust through the space encircled by the purse-string suture. Through this needle 500 c.c. of 1 per cent mercurochrome solution is allowed to flow into the rectum, thoroughly cleansing and disinfecting it. (Plate III, No. 3.) During the passage of the solution, while it is inflating the rectum, gentle massage upon the rectal wall is performed. This assists in saturating the rectal mucosa with the solution, which then passes out through a rectal tube previously left in position. The irrigation completed, the needle is withdrawn, and the puncture-hole immediately obliterated by drawing up of the purse-string suture (Plate III, No. 4).

Two stay-sutures (shown in Plate III, No. 2) are set in either side of the rectal wall, serving not only to hold the rectum upward, but also as landmarks to indicate approximately the position of the incisions about to be made in the rectal wall. The incision is made between the two stay-sutures, lengthwise, through serosa and muscularis, but leaving the mucosa intact. In making the incision great care must be exercised not to injure the vessels or in any other way to impair the blood supply (Plate IV, No. 1). The edge of the incision is now picked up and serosa and muscularis carefully separated by blunt dissection from the underlying mucosa, the separation being carried for a distance of about 1 cm. on each side (Plate IV, No. 2).

The ureter with catheter inserted is brought to the upper angle of the incision in the bowel wall, where it is placed in direct contact with the mucosa. A suture of No. 000 chromic catgut is passed through serosa and muscularis of rectal wall and

through the thin fibrous coat of the ureter, transfixing the ureter in position (Plate IV, Nos. 3 and 4). Serosa and muscularis are then brought together over ureter and inserted catheter, interrupted catgut sutures being used. The catheter, extending beyond the cut end of the ureter, holds open an artificial tube or canal, continuing to within 2 cm. of the lower angle of the wound. When closure of this tube or has been completed to this distance, the edges of that portion of the wound still remaining open are held apart by two mosquito clamps, which grasp mucosa and muscularis, exposing mucosa. Note that up to this point in the operation the rectum has remained unopened. This greatly minimizes the chances of infection taking place. The surrounding organs exposed in the wound are now packed off with aseptic gauze and the exposed rectal wall painted with 2 per cent mercurochrome. By plunging a sharp bistoury through the musoca, an opening not more than 0.5 cm. in diameter is made at the lower angle of the rectal incision (Plate IV, No. 5). To insure the permanent patency of this opening, it is "button-holed" by a continuous silk suture, encircling its entire circumference (Plate IV, Nos. 6 and 7). When suture of the "golf hole" has been completed the catheter is inserted through it into the lumen of the rectum and passed out through the anus (Plate IV, No. 8). The lower angle of the incision in the bowel is now sutured, completing its closure (Plate V, No. 1). The procedure in regard to both ureters is identical. The completed operation, showing the position of both ureters, is depicted in Plate V, No. 2.

The mechanical advantages obtained by the procedure just outlined are schematically represented in Plate V, No. 3. The ureter is shown entering the wall of the rectum between the serosa and muscularis above and the untraumatized mucosa below. The catheter is shown emerging from the cut end of the ureter and proceeding for a distance of about 5 cm. between the two upper and the

under coats of the rectal wall, before it passes through the permanent "golf-hole" in the musoca into the lumen of the rectum. There is thus provided an artificial tube or canal some 5 cm. in length, which intervenes between the extremity of the ureter and the fecal canal. This artificial tube, after healing of the sutured incision and removal of the catheter, will present only its wall of thin rectal mucosa to the fecal current, so that it will be readily

compressed by the passage of this material, thus affording a valvular action. The desiderata mentioned in a preceding paragraph have thus been obtained. Direct contact of the ureteral orifice with the fecal current is eliminated, and a collapsible tube with valvular action provided, minimizing the chances of infection. I wish to thank Dr. Clyde Deming and Dr. Vincent Vermoaten for their wholehearted cooperation and assistance.

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# THE CAUSATION, PREVENTION & TREATMENT OF POSTOPERATIVE DISTENTION OF THE ABDOMEN\*

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THERE probably is no more serious complication that confronts the abdominal surgeon than that of an acute intestinal obstruction, no matter what its cause, following some abdominal operation. Though this condition is called by various names, such as acute dilation of the stomach, ileus paralyticus, dynamic ileus, pseudo-ileus, the situation is always the same, namely, an enormous distention of the stomach or intestines without seeming power on their part to overcome it. The record made by the American Association of Obstetricians, Gynecologists and Abdominal Surgeons in assisting in clearing the way for a better understanding of surgical abdominal lesions is one in which we may feel a sense of good work accomplished at a time when progress everywhere in our profession has been so great, and yet to the active abdominal specialist there comes the full realization that in some channels we have much to understand to make more positive our saving of life.

What can we do to help the earnest research workers to unravel the hidden truths that bear upon the suddenly dilated stomach, the intestinal obstruction of the upper half of the intestinal tract and death after a most satisfactory operation? What is more distressing, when making the first morning visit, to have the house surgeon approach somewhat hurriedly with the statement, "Mrs. W., whom you left in such a fine condition last evening, has within the past hour given me much anxiety. I do not like her symptoms, and may we visit her at once?" We see the patient and recognize immediately a case of an acutely dilated stomach or upper intestinal tract. As we study her appear-

ance and the chart and recorded history we realize the desperate condition this patient is now approaching, and it exhausts our physical makeup and mental power more than the half dozen major operations performed the preceding day, And why? Because our line of treatment and that of many excellent operators has brought such a sad mortality. Sir Astley Cooper as early as 1823 in the *London Lancet* wrote upon the subject of acute intestinal obstruction, and ever since that time acute dilation of the abdomen has been in the fore in our surgical meetings.

## CAUSATION

An acute intestinal obstruction may be due to one of three causes: It may be purely mechanical in character, due to a band of adhesions, a kinking of the bowel, or some other cause where the obstruction is purely mechanical in character and not due primarily to some pathological condition in the bowel or abdominal cavity. The treatment here, of course, is immediate operation as soon as the condition is recognized. With this type of obstruction this paper does not concern itself. The second type of acute intestinal obstruction is that following a local or general peritonitis occurring either before or after the abdominal operation, and the third type of acute intestinal obstruction is that for which in lieu of a better term we use the name paralytic ileus or intestinal paresis.

Postoperative distention is most frequently due to paralysis or obstruction. In either event there is a failure of intestinal contents to move forward. If the obstruction is mechanical we have the protective mechanism of reverse peristalsis and vomiting. If it is paralytic this

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protective mechanism does not come into play; for the same forces that prevent onward peristalsis also prevent reverse peristalsis. In either event we have the absorption of intestinal contents with their concomitant effect on the metabolism of the individual.

When, at the time of operation, peritonitis has obviously begun, we can be fairly sure of an acute distention of the intestine later on. But this is a condition that the abdominal surgeon is not responsible for unless he has been careless in his technique, and while it does cause anxiety, it should not cause as much as when it appears unexpectedly and upon one of our most important cases.

Another cause of postoperative distention is unnecessary exposure of the abdominal viscera. Rough handling of the viscera plays an important part in postoperative abdominal distention. The abdominal viscera are delicate organs, and it is therefore reasonable to assume that they will resent any undue familiarity with them in the way of rough handling.

Furthermore, after a prolonged operation where much repair work has been done, the probabilities of acute dilatation are much greater, though we handle the intestines and other abdominal organs as gently as possible. Naturally the nerves of the intestines resent this prolonged handling and take this method to show their resentment.

Excessive hemorrhage, causing an anemic condition of the intestines, is a causative factor that must not be overlooked.

Another type is unquestionably due to an absorption of a certain amount of toxins from an overloaded intestine which has not been properly cleaned before operation.

Again there is a type to which we can give no reasonable explanation, and in which, even after an autopsy, we can find no cause, and which we must ascribe to some nervous peculiarity on the part of the patient.

Whether the type of anesthesia used (chloroform, straight ether, ether and oxygen, nitrous oxide and oxygen) enters into the causation has never been susceptible of demonstration. Other causes advanced for this condition are:

1. Drainage of the abdominal cavity, packing abdominal cavity with gauze during operation.

2. Too much surgery performed at one operation.

3. A too superficial examination of the patient before operation to determine whether any nervous defects are present.

Any or all of these factors may enter into the causation of the condition which we are discussing.

#### PREVENTION

As regards the prevention of this condition, I believe first of all that the majority of us are inclined to do too much surgery in the abdominal cavity at one operation. Because mechanically it is so comparatively easy to do a hysterectomy, cholecystectomy and appendectomy at one operation, is no reason that we should do so even on the most robust of our patients. I would prefer to perform two or three operations on one patient at different times, than to perform them at one sitting and have him subsequently run the risk of developing a paralytic ileus with its attending dangers and worries. In other words, the less surgery we do in the abdominal cavity at one time, the better. Also a thorough examination of the patient before operation is very essential and as little and as gentle handling of the abdominal organs as is possible.

#### TREATMENT

The treatment of postoperative distention is most disappointing, and but seldom successful, especially in the cases of postoperative ileus, and it is that particular class of cases to which I wish to call attention, together with the line of treatment followed in our clinic. In the treatment of these cases we are con-

fronted with factors not often considered. I refer to certain metabolic changes that occur in intestinal stasis. For the past four years I have been following every such case with detailed metabolic studies and am convinced that the following sequence of events occurs. First there is a decrease in the plasma chlorides followed by an increase in the non-protein nitrogen of the blood, both of which are associated with an increase in the carbon dioxide combining power of the blood plasma. A rising non-protein nitrogen is a serious omen and when it reaches 100 mg. or more the patient seldom recovers. I have found this simple observation of great prognostic value and estimating the non-protein nitrogen is one of the first things I always do in all cases of intestinal stasis.

Without going into detail it is sufficient to say that we have abundant experimental and clinical evidence that these metabolic changes are primarily of intestinal origin and that they can and do exist with little if any kidney impairment.

Reduced to terms of practical post-operative management the appreciation of this changed metabolism becomes of supreme importance. It is not enough that we direct our efforts toward relieving the stasis. We must also treat this altered metabolism.

In the face of a definite paralysis I do not believe surgical pituitrin is of much help. Occasional cases may be benefitted but as a routine it fails. These patients should have rest and to this end I avoid cathartics. Hot packs are applied over the entire abdomen and changed hourly except when the patient is sleeping; in such an event he is never disturbed.

The rectal tube and repeated enemas are useful in relieving the lower bowel but for distention high up they are useless. The fluid intake is maintained by saline given subcutaneously.

These are the usual and accepted methods of treatment and without minimizing their importance, I believe the proper management of the altered metab-

olism offers the patient more in the way of beneficial therapy than repeated enemas and hot packs.

We try to anticipate this complication in every abdominal case and knowing that the first change to occur is a decrease in the blood chlorides, we order normal saline by rectum as soon as the patient is sufficiently conscious to retain the rectal tube. This procedure is routine in all my cases and I believe it to be of immeasurable value. By doing this the chloride level of the blood is maintained and the first step in a serious metabolic complex is avoided.

If the blood chlorides are maintained the non-protein nitrogen will not rise and there will not be the same tendency to alkalosis. This point gives me an opportunity to condemn the giving of sodium bicarbonate by rectum on the theory that it prevents acidosis. These patients are already suffering from an alkalosis, why add to the condition by giving more alkali?

These simple procedures will save many cases from more serious complications but the condition is often advanced when brought to us. Fortunately other measures are still at our disposal. Attempts have recently been made to isolate the actual death dealing agent in intestinal stasis. These findings have confirmed what we have long suspected clinically, namely, that the higher up in the intestinal tract the stasis occurs, the more fatal and more rapid is its course. This is especially true in the region of the duodenum. Whether the poison is a toxin secreted by the duodenum mucosa or whether it is in the nature of a proteose remains to be seen. The essential feature is that it is elaborated high up in the intestinal tract and this furnishes the rationale for our so-called duodenal drainage.

As mentioned before many of these patients do not vomit. There is no forward or backward movement of intestinal contents and the disturbed mechanism is furnished with no other alternative than the absorption of these toxic products.

We have, then, the indications for their removal and while gastric lavages may help if done repeatedly, it is annoying to the patient and surgeon alike and for this reason is too often postponed.

I believe a far better procedure is to insert a small rubber duodenal tube through the patient's nose into the stomach and duodenum and by the principle of syphonage institute continuous drainage. The outer end of this tube must be kept lower than the stomach and can be fastened to a bottle at the side of the bed. The tube may be kept in place for several days and during this period the patient is allowed to take water by mouth as desired. The water temporarily satisfies his craving for fluids, dilutes the toxic secretions and with the aid of the tube favors continuous drainage. The nurse is furnished with a piston syringe and, if necessary, keeps the lumen of the tube open by occasionally forcing salt solution into the duodenum. This can be done and the patient not awakened.

We very rarely now perform a jejunostomy in these cases, preferring the use of the duodenal tube, and in my opinion obtaining better results with less danger to the patient. We have had no experience in the treatment of these cases by any serum, and while these may be of some value, their employment is as yet in the experimental stage, and the reports of their use are not very encouraging. Nor have we had experience with spinal anesthesia, as recommended by Mayer in 1922, and would rather advise against it as the risk incurred does not seem commensurate with the advantages which are claimed for this course of treatment.

I would like here to report briefly three cases in which we have used this treatment.

#### CASE HISTORIES

CASE I. J. S., aged sixty, pyloric stenosis. Physical examination before operation showed patient normal for a man of his years. Blood pressure 160/90.

Operation: Posterior gastroenterostomy. No particular difficulty about operation.

Patient did well for forty-eight hours, no nausea or vomiting, or even gastric distress; temperature and pulse normal. At the end of forty-eight hours, slight rise in temperature and pulse. Abdomen, especially in the epigastric region, slightly distended. Enema relieved distention. Non-protein nitrogen 50. At the end of the following twenty-four hours the patient commenced to have hiccoughs with feelings of nausea though no actual vomiting. But the epigastric region commenced to show that distended condition which obtains in acute dilatation of the stomach.

It was very evident that the patient was developing a case of acute dilatation of the stomach. The Levine tube was inserted through the right nostril and gastric drainage and lavage begun. The patient remained in about the same condition for three days when he gradually improved and made a good recovery. The drainage recovered 134 oz. during twenty-four hours. This patient also for the first few days felt so comfortable with the tube in that whenever it was removed, he begged to have it replaced. The tube remained in the duodenum for ten days. I am of the opinion that the use of this tube in this case, and with the continuous drainage which it maintained, saved his life.

CASE II. Mrs. S. E., aged fifty-eight, acute appendix.

Patient did very nicely for twenty-four hours when temperature and pulse began to rise and abdomen to distend. Levine tube immediately introduced into duodenum and large amounts of fluid, finally becoming fecal in character, recovered.

Patient died at the end of another forty-eight hours and at autopsy nothing abnormal was found save a few coils of distended intestine. There was no mechanical obstruction, no peritonitis and the appendicular wound was nicely healed. This was surely then a case of paralytic ileus but from what cause was never determined and while the use of the Levine tube made the patient much more comfortable it did not save her life.

CASE III. J. N. aged forty-five, interval operation for a chronic appendix (usual operation).

Good convalescence for forty-eight hours when signs of a paralytic ileus began to develop. Rise in temperature and pulse, gradually

distention of abdomen, soft in character, not hard as in peritonitis, and some feeling of nausea. N.P.N. 40.

Levine tube was immediately inserted and left in for forty-eight hours. Drainage at first was bile stained, then bile and then frankly fecal. Stomach was washed out every six hours with plain water and at end of forty-eight hours drainage became less fecal in character, and patient passed some flatus per rectum. Patient was then fed small quantities through tube which was retained. Tube was permanently removed at end of another twenty-four hours and from then on patient made an uneventful recovery and has remained well ever since, two years.

In this case there was no mechanical obstruction because there was no tumor mass to be felt and no reverse peristaltic movements of the bowels.

The technique of this method has been worked out by my assistant, Dr. Nelms, and myself; in fact he first suggested the procedure to me and should be given much credit.

So far my colleagues and I have had 15 cases of abdominal distention in which I

have used this method; 10 of these have recovered and 5 have died. But I am firmly convinced that of the 10 who lived, 5 at least would have died by the ordinary treatment of jejunostomy, etc.

Some years ago Dr. Willy Meyer wrote an article on this subject in which he advocated the use of a tube somewhat larger than the Levine tube, but not in the same way as I have outlined here.

In conclusion I make a plea for more conservatism in abdominal operations and wish to emphasize the fact that post-operative distention of the abdomen is most always accompanied by intestinal stasis. As a result of this stasis we have absorption of intestinal contents resulting in the metabolic triad of low blood chlorides, high non-protein nitrogen and an increase in the carbon dioxide combining power of the blood plasma. The indications, therefore, are to maintain the blood chlorides by vigorous chloride therapy and to remove the toxic intestinal contents by continuous duodenal drainage.



DIAGNOSIS & TREATMENT OF  
ACUTE INTESTINAL OBSTRUCTION  
INVOLVING THE SMALL INTESTINE\*

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THIS paper is limited to the consideration of acute small bowel obstruction, the early diagnosis of which is of great importance in saving human life.

Haggard<sup>1</sup> quoting Sir William Taylor states: "The mortality in primary acute intestinal obstruction is nearer 60 per cent than it is 35 or 40 per cent, as usually given." The cause, type or location of obstruction in small bowel, whether simple or strangulated, seem to make little difference in the symptoms, but does influence the rapidity and gravity of the disease. The early symptoms that should lead to a probable diagnosis are abdominal pain, nausea, vomiting, prostration, early pulse and temperature normal, temperature sometimes subnormal. The pain may follow a period of discomfort and general depression. The character of the pain is of great importance. Peristaltic pains are rhythmic, increasing in intensity and coming at regular intervals, with short periods of relief for the first twelve or twenty-four hours, when paresis may set in, pains gradually disappearing, followed by abdominal distention, periodic vomiting, cold, leaky skin, rapid and weak pulse. The pain is usually around the umbilicus or epigastrium. With epigastric pain, we realize the importance of ruling out coronary disease in patients over forty years of age and have it differentiated when necessary by an electrocardiogram. Nausea is very transient and is of less significance than vomiting. The first vomiting is projectile, with rapid emptying of stomach contents, and unless fluids are withheld, bile, followed by stercoraceous material, is expelled. The extent of pros-

tration depends upon the amount of vomiting, violence of pain, and the presence of actual strangulation with vascular disturbance. The important matter is to recognize the obstruction, withhold devastating purges and seek early operative relief. The textbooks give a very full symptomatology, and when all of these are present the patient is in extremis. It is important to know the early signs of intestinal obstruction. The triad of obstipation, vomiting, and rhythmic abdominal pains is sufficient on which to base an early diagnosis, especially in a patient previously operated upon abdominally or who has an old hernia. The vomiting and the colicky abdominal pains should excite suspicion; repeated enemas, two or three, the last two without results, confirm the diagnosis. It is a pity that enemas cannot be popularized and given in pill form with as much ease as are purges, for thereby the mortality in acute abdominal diseases would be greatly reduced. It is better to explore an abdomen and find it negative than not to explore and find obstruction at autopsy.

Dr. C. T. Smith, of Park View Hospital, in a recent paper before the Fourth District Medical Society, summarizes the urine and blood findings in obstruction as follows: "The presence of albumin, casts, and blood in the urine are fairly constant findings in acute intestinal obstruction. The blood urea will increase after twenty-four hours, and a persistent rise makes the prognosis grave. The total leucocyte count is apt to be misleading. The differential polymorphonuclear count is more reliable." He further states, "The

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temperature, pulse and blood pressure form no criterion as to the illness of the patient or his chance of possible surgical recovery."

In the past fifteen years 134 patients suffering with acute small bowel intestinal obstruction have been admitted to Park View Hospital to the service of Drs. Boice and Willis and operated upon by both or one of them. It is more imperative to operate upon these patients as soon as the diagnosis is made than in acute appendicitis; many operations were performed around and after midnight. Twenty two, 16 per cent, of these died following operation, 2 of them on the operating table. None was denied operation, no matter how desperate the condition. We have further divided the deaths into institutional, in the hospital forty-eight hours, and non-institutional, under forty-eight hours. Fourteen died after forty-eight hours (institutional deaths) and 8, under forty-eight hours (non-institutional deaths). Forty-two of these patients were enterostomized, and among these, 17 of the deaths occurred. The high death rate in this class of case is probably due to their more desperate condition. Six had simple enterostomy with aspiration of bowel content and immediate closure of opening in bowel. One of these died.

The immediate anatomical cause of the obstruction was a band or bands in 39, adhesions in 31, intussusception in 3, femoral hernia in 7, inguinal hernia in 46, paresis in 2, stricture perforation in 2, simple stricture 1, caught in appendix abscess wall 3. Fifty-seven of these 134 patients had been operated upon abdominally; 43 of the 57 had been operated upon from months to years previously, and 14 were still in the hospital when the obstruction developed. Nearly 42 per cent had been operated upon abdominally. Ninety-six, 71 per cent, of these 134 obstruction cases had either been operated upon abdominally or had herniae, the latter containing partially strangulated small bowel. There were 3 deaths among

the 46 incarcerated small bowel inguinal herniae, and 1 death in the 7 femoral herniae. The mortality was 7.5 per cent in the inguinal and femoral hernia patients. In 10 patients it was necessary to resect or repair the bowel.

It is difficult to say definitely just when complete obstruction takes place in any patient. Symptoms may be present but obstruction not occur for many hours after onset. We have assumed that the obstruction began with the beginning of symptoms. In the case of incarcerated small bowel in hernia it is fairly accurate to date the time from descent into hernia.

According to the time elapsing between beginning of symptoms and operation, the deaths in the various periods were as follows:

	Cases	Deaths
Less than 24 hours.....	27	1
24 to 48 hours.....	43	5
48 to 72 hours.....	14	6
Over 72 hours.....	27	8
Time not recorded.....	23	2

Among those that were enterostomized the deaths in similar periods were as follows:

	Cases	Deaths
Less than 24 hours.....	3	0
24 to 48 hours.....	14	6
48 to 72 hours.....	9	4
Over 72 hours.....	15	7
Time not recorded.....	1	0

The treatment of all these cases has been similar because my associate, Dr. E. S. Boice, and I many years ago arrived at the opinion that these patients needed normal saline early and in large amounts. They did not do well if allowed water by mouth. Our first enterostomy was done in 1919 to evacuate the large amount of liquid feces above an obstruction. We decided to sew in the catheter for drainage. This was largely empirical treatment, but its virtues and the correctness of our observations have been proved by the splendid work of Orr and Haden,<sup>2</sup> Foster,<sup>3</sup> Foster and Hausler,<sup>4</sup> McIver and Gambel,<sup>5</sup> Trusler,<sup>6</sup> McVicar and Weir,<sup>7</sup> and others, in their recent experimental and

chemical studies in obstruction. We have added dextrose solution intravenously and rectally, but otherwise have made no change in treatment for years.

Foster divides obstruction simply into two classes, as follows: (1) "Such cases as bands and adhesions which cause acute simple obstruction of the continuity of the gastrointestinal tract without primary vascular derangement; (2) Those, such as volvulus, incarcerated herniae, and intussusception, in which there is a variable length of intestine obstructed as well as an interference of the vascular supply to it." This second group he has called acute intestinal strangulation. We consider this a very simple, satisfactory and workable classification.

The essential treatment of all obstruction, in our opinion, is to combat the dehydration, the loss of sodium chloride, the resulting alkalosis, rarely acidosis, the toxemia from strangulation, the kidney depression and finally, to reestablish bowel continuity. Operation is performed immediately unless the patient is too ill, when time should be taken for giving dextrose saline solution and the application of heat to improve the general condition. This can often be done while preparations are being made in the operating room.

Subcutaneous or intravenous administration of normal or of 2 per cent saline (intravenously) in 3000 c.c. of water given in twelve hours, 1000 c.c. doses at four-hour intervals, will overcome the dehydration, and reestablish the sodium and chloride ion balance which, in turn, successfully combats the alkalosis. If 100 gm. of dextrose are added to each 1000 c.c. of saline solution, the kidney depression will be overcome unless the kidneys have been greatly damaged. In giving the combined saline dextrose solution of this strength, it is necessary to administer it intravenously. Saline dextrose by rectum is used chiefly to cleanse the bowel. Its retention and absorption by the bowel is too uncertain to risk the life of the patient.

We start the subcutaneous use of saline simultaneously with the operation.

Next in importance is the choice of anesthetic. This should be governed by the general condition of the patient and by the mechanical difficulties present, such as obesity and deep pelvic location. We have long recognized that the intra-abdominal obstruction cases of the same duration are more desperately ill than are those of incarcerated hernia which we classify as extra-abdominal. The reason for this we do not know unless it is due to the tightly constricting ring preventing the peritoneal absorption of the products of decomposition secondary to strangulation. We think the following case shows the lack of peritoneal absorption:

A robust colored man, aged twenty-six, previously in good health, entered with large strangulated hernia of sixteen hours' duration. Temperature 98.2°, pulse 82, systolic blood pressure 140, leucocyte count 8000, blood urea 45. At operation he was found to have 6 feet, 8 inches of strangulated gangrenous bowel composed of ileum and cecum with their mesentery. On making incision through skin, there was distinct odor and discoloration of underlying tissue. When the sac was opened, dark bloody fluid with very offensive odor escaped. The bowel was hopelessly gangrenous. Since the patient's condition seemed favorable, resection was thought feasible. A second low, right rectus, abdominal incision was made, cavity walled off, strangulated bowel released, and, to our great surprise, patient went into profound shock and died on the table before resection could be completed. Saline had been started as usual, and he was under ether anesthesia. We attributed his death to unknown toxin or histamine.

For all desperate cases and elderly persons, we use local anesthesia, sometimes supplemented by gas-oxygen; for others, ethylene or ether. We do not favor a high enterostomy without the release of the obstruction. In 2 cases in which we did this the patient died. Large quantities of material were drained off through the enterostomies but the patients never rallied sufficiently to warrant a second operation.

Postmortem showed one to have a simple band, and the other, short intussusception, the release of which would have added very little to the operative risk. Forty enterostomies were done upon the intra-abdominally obstructed, while only two extra-abdominally obstructed (herniae) were so treated, yet in many of the latter the bowel was apparently damaged as much as in the intra-abdominal obstructions.

The incision is made at the point most serviceable for releasing the obstruction, which is done with as little trauma and as rapidly as possible. The enterostomy should be located in healthy bowel about 10 or 12 inches above the obstruction, using two rows of simple purse string sutures, the first of which is passed through the tube, attaching it to bowel. It is important, on opening the bowel, to introduce a suction tube, and quickly and gently evacuate the contents of the bowel, passing the aspiration up and down the lumen. We agree with others that this material should not be allowed to enter the collapsed, "thirsty" bowel below the point of obstruction. Making the enterostomy opening in the greatly distended bowel, thus reducing the abdominal contents, often facilitates finding the cause of intra-abdominal obstruction. In a few cases several openings were made and closed immediately after aspiration. The enterostomy tube is brought out at either end of the incision or through a stab wound, following the Mayo method in the use of omentum about the tube. Following operation the bowel is irrigated with 2 per cent salt solution, oz. 2, every two hours during the next forty-eight hours. Morphine should be given in sufficient quantity to quiet peristalsis and patient.

Cardiac and respiratory stimulants such as epinephrin, ephedrine, coramine, atropine, large doses of caffein sodium benzoate, and others are given as indicated.

Gastric lavages are done when there is much vomiting. Fluids by mouth are withheld for twenty-four to forty-eight hours, and longer if indicated. These patients should receive large quantities of fluids, 3000 to 5000 c.c., subcutaneously or intravenously. Disagreeable gastric lavage, except at the time of operation, is no longer a necessity when obstructions have been released, oral fluids withheld and subcutaneous saline given in the amounts here stated.

#### SUMMARY

The factors of importance in acute intestinal obstruction are:

1. Early recognition of acute intestinal obstruction which offers the greatest hope for lowering the mortality.
2. The application of modern treatment, on the basis of our newer knowledge, to overcome the dehydration, alkalosis and kidney depression.
3. Proper selection of anesthetic for the individual case.
4. The judicious use of enterostomy in the healthy bowel above the obstruction, and not the empirical use of high jejunostomy.

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# MEATOTOMY WITH SUTURE OF CUT EDGES OF SKIN & MUCOUS MEMBRANE\*

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**M**EATOTOMY, although a minor operation, is frequently neglected and often crudely done. A small meatus, 26 F. or less, should be incised when one or more of the following indications exist: non specific urethritis, unusually persistent or recurrent specific or non-specific urethritis, frequency of urination or other urinary disturbances, for diagnosis and treatment of stricture, both congenital and acquired, for cystoscopy and cysto-urethroscopic investigations, and to lessen the tendency to hernia in boys when the meatus is very small. Hernia has been noticed in boys with a small meatus sufficiently often to lead us to think that it acts as a causative factor.

The usual method of performing a meatotomy is simply cutting the meatus under local anesthesia to the desired size, usually 30 or 32 F. Some operators then wrap the penis with gauze and a bandage, and subsequently open the meatus with large sounds every few days to prevent the cut edges from healing together. Others apply Monsell's solution, concentrated silver nitrate or such agents to the cut surface to check bleeding, lessen pain on voiding and prevent the healing without the necessity of sounds.

Among the disadvantages of meatotomy as performed in the usual way are:

1. The painful tearing apart every day or so by sounds to prevent the edges from healing again.

2. Hemorrhage is sometimes an annoying feature in ordinary meatotomy operations when caustic agents are not employed; this is usually more annoying to the patient than to the surgeon.

3. The result is often not a normal-looking meatus.

4. In those instances where caustic agents are used there is a tendency to contraction and later constrictions of the meatus.

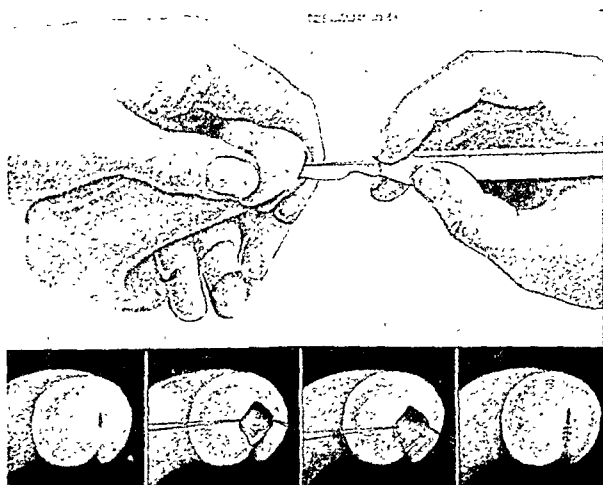


FIG. 1. Meatotomy. Inserts show method of closing mucosa to skin using uncut sutures as retractors to facilitate introduction of lower sutures.

5. Not infrequently there is spraying of the urine.

In order to overcome these disadvantages of meatotomy, as ordinarily performed, we began some time ago to suture the cut edges of the skin and mucous membrane with ten day, 00 chromic catgut. Since the adoption of this technique we have performed 119 meatotomies with results so satisfactory and so free from the usual disadvantages of the other methods that we are still enthusiastic about the suture method of meatotomy.

## TECHNIQUE

Preliminary to the injections of novocaine about  $\frac{1}{2}$  oz. of a 1 or 2 per cent. solution of novocaine is injected into the urethra and held for two or three minutes. This partially anesthetizes the mucous membrane so that the needle puncture

can be made just on the inside of the meatus through the mucous membrane with less pain than through the skin. One of two drops of adrenalin solution is added to the novocaine to lessen the bleeding at the time of the operation and thus facilitate suture. After the incision is made, the first sutures are placed at the outer edges of the cut, catching only the skin and mucous membrane in the sutures. Reaching the deeper part of the mucous membrane is made easier by temporarily leaving the 2nd or 3rd stitches long and using them as retractors to open up the meatus and expose the inner margin of the mucous membrane. (See Fig. 1.)

In our experience, meatotomy performed in this way is definitely superior to the other methods. The operation

requires five or ten minutes longer, but the final results more than justify this slightly longer time. Occasionally the shape of the glans penis and meatus make it desirable to cut the upper, not the lower, part of the meatus.

The advantages of this method are:

1. Healing is more prompt.
2. There is no necessity of passage of sounds to keep the meatus open while healing.
3. There is less pain and practically no hemorrhage.
4. There is no tendency to become narrow again as with the usual methods.
5. After the absorption of the sutures there is no spraying of urine.
6. The cosmetic and final results are better.



# SODIUM ISO-AMYL-ETHYL BARBITURATE

## SODIUM AMYTAL IN THE PRELIMINARY PREPARATION OF PATIENTS FOR REGIONAL ANESTHESIA\*

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THE increasing use of procaine for regional anesthesia is the result of improved technic in nerve blocking, better control of subdural anesthesia, and a general desire on the part of anesthetists and surgeons to avoid inhalation anesthesia when possible. It follows that larger quantities of procaine are being used, for example, in nerve blocking, and that the toxic manifestation occasionally observed from the use of this drug may become increasingly important.

Tatum, Collins and Atkinson,<sup>1</sup> and others have demonstrated the value of barbital in preventing acute cocaine intoxication in animals, and Loevenhart<sup>2</sup> and his associates have shown that the acute intoxication in animals resulting from procaine may be prevented by the use of barbital or sodium iso-amyl-ethyl barbiturate (sodium amytal). Isenberger<sup>3</sup> and his associates concluded from their work on dogs at the Mayo Clinic that sodium iso-amyl-ethyl barbiturate protected against convulsions resulting from the use of procaine, but that it did not prevent the depression brought about by overwhelming doses of procaine. They found that "the combination of iso-amyl-ethyl barbiturate or other safe barbituric acid hypnotic, with properly controlled ventilation, offers the greatest hope for the saving of life in cases of severe poisoning by procaine."

Beside the toxic manifestations occasionally observed from the use of procaine, there is the disadvantage of the psychic trauma associated with the operation. The average patient prefers to know little or nothing about the operative procedure; therefore, it becomes important to prepare the patient more carefully than when a general anesthetic is to be given.

Lundy<sup>4</sup> has reported the use of sodium iso-amyl-ethyl barbiturate in combination with other preliminary medication in 730 surgical cases. In these, there was little, if any, delirium; nausea rarely occurred, and there were no respiratory difficulties. He considered preliminary medication employed brought the patient to the operating room with a good mental attitude toward local anesthesia whether the patient had favored it prior to the operation or not.

In previous publications<sup>5</sup> we have discussed at length the use of sodium iso-amyl-ethyl barbiturate in surgical and non-surgical cases. Drabkin<sup>6</sup> and his associates, Weiss<sup>7</sup> and others<sup>8</sup> have also reported their experiences with the use of barbituric acid derivatives used in man for a variety of conditions. It is the purpose of this publication to report our experiences with a small series of surgical cases in which sodium iso-amyl-ethyl barbiturate was given prior to the local infiltration of the tissues with procaine.

### PREPARATION OF THE DRUG

Sodium iso-amyl-ethyl barbiturate is prepared in a pure anhydrous form, and, when sealed in glass vessels for protection against moisture and carbon dioxide, a perfectly stable compound is assured, even when subjected to severe durability tests.

The hydrogen-ion concentration of the preparation is adjusted so that a 10 per cent solution in triple distilled water will show pH values ranging between 9.5 and 9.8. On animals this pH range has given the maximum anesthetic effect with a minimum degree of toxicity. These points, we feel, are important when the drug is to be injected into the blood stream.

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## ADMINISTRATION AND DOSAGE

Sodium iso-amyl-ethyl barbiturate may be administered by mouth, rectally, intramuscularly or intravenously. For rectal, intramuscular or intravenous injection, the drug is prepared by adding the anhydrous sodium salt to triple distilled sterile water, making a 10 per cent solution. The sodium salt should be thoroughly dissolved by gentle agitation, and the resulting solution should be essentially water clear. Solutions which are opalescent should be discarded, and a clear solution should not be allowed to stand exposed to the air for any great length of time if it is to be used for intravenous injection. The rate of intravenous administration should not exceed 1 c.c. per minute.

The patients were observed closely during the period of slow administration for their reaction to the drug. This individual reaction gave, in our opinion, the most valuable indication of the correct dosage required for the patient. As a rule, the patients went to sleep after the administration of from 0.3 to 0.5 grams ( $4\frac{1}{2}$  to  $7\frac{1}{2}$  grains), though occasionally a patient required more or less than that amount. The dosage that induced profound sleep, the solution being given at a uniform rate, was a guide to the amount of the drug required to produce a desired effect. In a few patients the intravenous dosage was limited to the amount that would produce drowsiness without inhibiting cooperation.

When only mild sedative effects, and when cooperation of the patient is desired, the drug may be given orally the night before in doses of 0.2 to 0.3 gram (3 to  $4\frac{1}{2}$  grains) in about 15 c.c. of water and repeated one-half to one hour before the time of operation. It is better, however, to administer it in capsules as the drug is very bitter to taste.

The dosage of sodium iso-amyl-ethyl barbiturate varied from 7 to 20 mg. per kilogram of body weight. Apparently, however, there is only a very approximate relationship between body weight and dosage. The age, nervous temperament,

metabolic rate and the physical condition of the patient are factors of such importance as to render impracticable any attempt to grade dosage entirely on body weight.

Children and adults with hyperthyroidism required more than the normal adult in proportion to their weight. Patients of a very nervous temperament required larger doses than the average, while apathetic individuals reacted to smaller doses. Elderly persons and those whose resistance had been lowered by chronic illness or who were on the verge of shock, reacted to considerably smaller doses of the drug than did vigorous, healthy individuals.

Irrespective of these various factors, however, some persons without any evidence of idiosyncrasy to the drug were apparently more susceptible to the effect of sodium iso-amyl-ethyl barbiturate than were others; hence, the fundamental importance of careful and intelligent observation during a period of slow administration of the drug.

When given by mouth or by rectum, the rate of absorption makes it difficult to obtain exactly the effect desired, when needed, without giving more or less of the drug than is required. If one gives doses by mouth, rectally, or intramuscularly, large enough to produce unconsciousness, one can never be certain that a continued absorption of the drug may not occur for some time afterwards, thus leading to a prolonged cumulative action. It is possible to produce a cumulative action in man by giving repeated intravenous injections before the initial and subsequent amounts of the drug are eliminated, or it is possible to overwhelm the patient with a single large injection. One can demonstrate this with any of the inhalation anesthetics, especially ether and other less volatile anesthetics.

If loss of consciousness is desired, in our opinion, the safest and most satisfactory manner is to administer the drug intravenously. By carefully watching the patient during the time the drug is being

injected, one is able to control the dosage as the effects of the drug are obtained almost immediately and the results are more uniform. The rate of absorption then becomes a negligible factor, and, in addition, one obtains the peak effect of the drug when needed. It has also been our experience that patients regain consciousness much sooner after the intravenous injection of the drug than they do when the same amount is given by mouth, per rectum or intramuscularly.

#### GENERAL EFFECTS

The general effects refer chiefly to those observed during and after the intravenous injection of the drug. During the time of injection observations were made relative to blood pressure, mental reaction, rate and amplitude of the respirations, and color of the skin. Within three to five minutes after the intravenous injection was begun, the patients became drowsy. Shortly thereafter they fell into a profound sleep, often developing a snoring type of respiration. As a rule the patients were carried rapidly through the first stages of anesthesia so that excitement, laryngospasm, nausea and vomiting were rarely observed. Many of the patients lost consciousness in the midst of an incomplete sentence.

The pupils were usually slightly constricted or normal in size. The gag reflex was present in essentially all instances. The knee jerks were absent in this stage, and there was slight dilatation of the rectal sphincters. The skin reflex was practically never absent. The degree of muscular relaxation varied with different individuals, but was rarely complete with the administration of 1.0 gram (15 grains). The respirations following the loss of consciousness were usually decreased in amplitude, were regular, and were apt to be slightly increased in rate, though frequently they remained normal. There was little change in the color of the skin, although occasionally a slight degree of cyanosis or considerable blanching occurred.

#### EFFECTS ON PULSE RATE AND BLOOD PRESSURE

The pulse rate during and shortly after the completion of the injection varied somewhat. The rate was usually increased, was very seldom decreased, and often it was unchanged from normal. The pulse volume decreased during the time the temporary fall in blood pressure occurred.

The blood pressure nearly always decreased during the time the drug was being injected, but, as a rule, it returned to its previous level within a few minutes. In a recent publication,<sup>5</sup> charts illustrating this fall in blood pressure were presented. This temporary decrease in blood pressure usually amounted to 20 to 30 mm. of mercury. Marked decreases in blood pressure have been observed in patients with hypertension, elderly people with arteriosclerosis, and in patients with unstable cardiovascular systems. In these types of patients, it is an advantage to determine this while injecting the drug intravenously, so that the further administration of the drug may be discontinued.

#### METABOLIC EFFECTS

It has been shown in a previous publication<sup>5</sup> that there is a negligible change in blood sugar, CO<sub>2</sub> combining power and non-protein nitrogen. Also, urine examinations were essentially normal except for a trace of acetone and a slight decrease in the twenty-four hour volume output for the first few days after the operation. These observations were made when the amount of sodium iso-amyl-ethyl barbiturate administered was sufficient to produce general anesthesia uncomplimented by other anesthetics.

The small series of surgical cases reported here includes the following types of operation: Laparotomy 31, otolaryngology 9, thyroidectomy 6, rib resection 4, and prostatectomy 2. The average amount of sodium iso-amyl-ethyl barbiturate administered intravenously prior to the local infiltration of the skin and deep



tissues ranged between 0.3 and 1.1 grams ( $4\frac{1}{2}$  to  $16\frac{1}{2}$  grains).

#### OBSERVATIONS

In 29 patients, there was an absence of any sign of stimulation during the period of operation. Slight stimulation manifested by movement of the hands and feet occurred in 15 patients. Restraint of the arms and legs was found necessary to avoid contamination of the operative field in 6 cases; while 2 patients reacted to such a degree that nitrous oxide and oxygen or ether was given in order to proceed with the operation. Patients whose sleep was induced with sodium iso-amyl-ethyl barbiturate and who became restless during operative procedures so that in some instances they talked incoherently, on awakening recollected nothing that occurred during the time of operation.

It was further observed that unless the dose of the drug was moderately large, the degree of muscular relaxation approximated that obtained when local anesthesia was used alone. In those patients where there was a definite reaction to stimulation, a decided muscular resistance was present.

#### DISCUSSION

The combined use of sodium iso-amyl-ethyl barbiturate and procaine anesthesia gave satisfactory results in approximately 50 per cent of the cases. The patients were asleep and were relieved of excitement; especially was this sleep beneficial in operative procedures in children where the surgeon desired to use local anesthesia. It proved to be an aid to the surgeon, and freed the patient from the apprehension and mental trauma, which, as a rule, contraindicates the use of local anesthetic agents in children. A similar advantage was experienced in its use in the apprehensive and nervous adult patients.

Five patients, almost in a condition of shock from intestinal obstruction, hemorrhage, or trauma, were successfully operated under an anesthetic of from 0.3 to

0.5 grams ( $4\frac{1}{2}$  to  $7\frac{1}{2}$  grains) of sodium iso-amyl-ethyl barbiturate intravenously and procaine locally.

The injections of procaine were done by several different men, as were the operations. The injections were not all perfect, and, in some instances, the surgeons were not accustomed to operating with local anesthesia, especially for abdominal work. These variable factors, no doubt, accounted for many of the difficulties experienced. On the other hand, there were a few patients who reacted after what seemed to be perfect injections of procaine. These cases suggested the possibility that sodium iso-amyl-ethyl barbiturate may have interfered in some manner with the effectiveness of the procaine anesthesia. This point is being investigated further.

Greater nursing care was found to be necessary for several hours following the time of operation when this type of anesthesia was used. This was especially so when doses of 1.0 gram (15 grains), or larger, were employed. The patients not only slept for several hours after the operation, but were more apt to be restless and temporarily disorientated on awakening. In our experience it has been preferable to employ the various methods of general or spinal anesthesia rather than to give comparatively large doses of sodium iso-amyl-ethyl barbiturate intravenously in combination with local infiltration of the tissues with procaine.

We are of the opinion that for sedative effects the administration of 0.3 to 0.5 grains ( $4\frac{1}{2}$  to  $7\frac{1}{2}$  grains) of sodium iso-amyl-ethyl barbiturate combined with  $\frac{1}{8}$  to  $\frac{1}{4}$  grain of morphine, given one-half to one hour prior to the local injection of procaine, is most satisfactory. For those patients who are very apprehensive about the local use of procaine and desire to be unconscious, we advise the intravenous use of the drug. Just enough should be given to produce a sound sleep. This amount seldom exceeds 1.0 gram (15 grains).

## SUMMARY

1. Sodium iso-amyl-ethyl barbiturate, when used intravenously or orally with morphine ( $\frac{1}{6}$  to  $\frac{1}{4}$  grain, given hypodermically) to produce analgesia and narcosis short of sleep, was a very effective preliminary preparation for local anesthesia.

2. The intravenous injection of sodium iso-amyl-ethyl barbiturate sufficient to produce sound sleep is advised only in those patients who desire to be unconscious or in children and uncooperative patients to whom local anesthesia is to be given.

3. It is seldom necessary to give adult patients more than 1.0 gram (15 grains) of the drug at one time to produce profound narcosis.

4. The drug, prepared in a 10 per cent solution, when administered intravenously, should be given at the rate of approximately 1 c.c. per minute, with careful observation of the patient during the time of the injection. By this means one is able to more or less control the dosage.

5. Sodium iso-amyl-ethyl barbiturate acts as a prophylactic measure in counteracting the toxic manifestations of procaine occasionally observed when local anesthesia is employed.

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# POINTS IN THE QUARANTINE IN ABDOMINAL SURGERY\*

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THE excellent argument by Dr. Robert C. Coffey,<sup>1</sup> on protecting the peritoneal cavity from local infection, merits the careful study of every surgeon.

There are three maneuvers which, with the same object in view, I have been employing for very many years and with the utmost satisfaction:

1. In dealing with an infected gall bladder, whether tube or cigaret drainage is necessary, the omentum is pulled up and tucked in below the liver and the drain, a stitch or two being inserted to keep it from becoming displaced. This disposition of the omentum "quarantines" the general peritoneal cavity, and at the same time obviates the formation of adhesions between the liver and bowel which sometimes prove serious.

2. In making appendicitis operations, in cases in which drainage will probably be necessary, a right rectus incision is made, through which, after protecting by a cofferdam of sponges, the appendix is removed and the abscess mechanically cleaned. A stab incision is then made well over in the general region of the anterior superior spinous process, the location of the stab being determined by the fingers on the inside so as to have the drain at the best possible point for reaching the abscess cavity. The stab opening is made by making a skin incision about 1 inch in length, parallel with the fibers of the external oblique, through which is forced a pair of sharp-pointed scissors; the scissors are then partly opened so as to enlarge sufficiently the drainage track. A hemostat is passed along the side of the scissors and the ends of the ligatures,

which have been used on the meso-appendix and the appendix stump, are caught and withdrawn. The hemostat is again introduced and one end of the drain is withdrawn carefully, together with the scissors, so that the far end of the drain can be nicely placed in the pus cavity. With the inside fingers the cecum is pushed well over to the right, aided by slight traction on the protruding ligatures. The cofferdam is withdrawn, the omentum brought over so as to protect the general cavity more completely, the main incision closed in layers as usual, and a single silkworm-gut stitch so inserted in the skin at one end of the stab incision as to catch the protruding ligatures and drain. In case the infection has extended into the pelvis, the drain is extended to the bottom of the culdesac and still by proper manipulation it can almost invariably be so placed as to avoid contact with the small bowel, and thus obviate postoperative ileus. The drain is a dressed tube or a cigaret of gauze and tissue as indicated.

The patient is encouraged sometimes to lie on the right side for a few hours, but that is probably unimportant. There seems to be no tendency whatever for the omentum or cecum to pull away from the site of the drainage. The drain is usually removed in five to seven days. The catgut ligatures come away of themselves. The unavoidable contact of the necrotic appendix and of the pus with the subcutaneous fatty tissue of the abdominal incision usually results in its infection, but when the stitches are left undisturbed, as advised several years ago by Graham, of Chicago, the pus usually finds its way out between the stitches and healing takes place very satisfactorily, though sometimes slowly. Occasionally, however, it becomes necessary to remove the stitches, or part of

<sup>1</sup> Application of the principle of the quarantine in abdominal surgery. *Ann. Surg.*, 85: 808, 1927.

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them, to get better drainage, but this usually results in the later necessity of curetting and sterilizing the exposed surfaces and re-inserting stitches to bring them into apposition.

3. This is the most important of all, and has given me many successful results which would not otherwise have been obtained:

In cases in which removal of the uterus and its appendages leaves the denuded pelvis the seat of extensive infection, the round ligaments are implanted in the vault of the vagina as usual, the posterior wall of the vagina split down to about the bottom of the culdesac, the distal ends of two or three strips of washed iodoform gauze introduced into the vagina and the rest of the strips made into a fluff lightly filling the pelvic cavity. (If it has been possible to save the ovaries, these are attached pretty high up on each side so as to be out of the way of future trouble, since if allowed to drop into the culdesac they will frequently prove a source of pronounced dyspareunia.) The sigmoid is then swung around over the gauze and attached with continuous catgut to the margin of the healthy peritoneum, so as to make a complete roof to the pelvis. Over this the omentum is then pulled down so as to protect still further. There has thus been secured a very complete partition between the infected pelvis and the uninfected abdominal cavity. In attaching the sigmoid the stitches are inserted so as to catch some of the fibers of one of the longitudinal bands or the tissues of the mesosigmoid, being careful to avoid the vessels, or some of the appendices epiploicae can be utilized. It is so attached as to cover all the raw surfaces. In rare cases the sigmoid may be so short as to

require mobilization of the cecum in order to complete the partition by attaching the two together.

This mobilization of the sigmoid was advised by a western surgeon a good many years ago, but his name I do not recall. I have never seen it used by anyone except myself; but it is one of the most valuable maneuvers that I know of to secure the desired end. I have found it particularly valuable in those cases of puerperal infection with thrombophlebitis in which the uterus is removed and the infected pelvic veins left wide open for drainage. Within a very few hours adhesions form, making the protection perfect. The mobilized sigmoid is held up by the gauze fluff, which is withdrawn through the vagina at the end of one week. Vaginal douches are used afterwards as needed for cleanliness. The sigmoid gradually settles down and makes a complete covering for the pelvis. Care should be used to avoid any sharp kinks in attaching the sigmoid, but if that is done there would seem to be no danger of postoperative ileus.

In cases in which there is no infection present but as a result of extensive pelvic adhesions from fibroids, ovarian tumors, etc., the pelvic peritoneum has disappeared, the same technique of introducing the fluff and mobilizing the sigmoid has been equally satisfactory in obviating adhesions. If the uterus is to be left, the vagina is opened freely into the culdesac and the gauze strips placed through that opening.

By the technique described I have not for many years had a single case of post-operative ileus, though I have known of the occurrence of many cases in the hands of colleagues who have not employed these methods.



# A METHOD OF DRAPING FOR OPERATIONS ON THE NECK\*

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IN operations on the neck, especially thyroidectomy, the operative field is usually isolated from the patient's

tion and storing, it is folded once again in the same direction, bringing points g to c and h to d, thus leaving the "zipper"

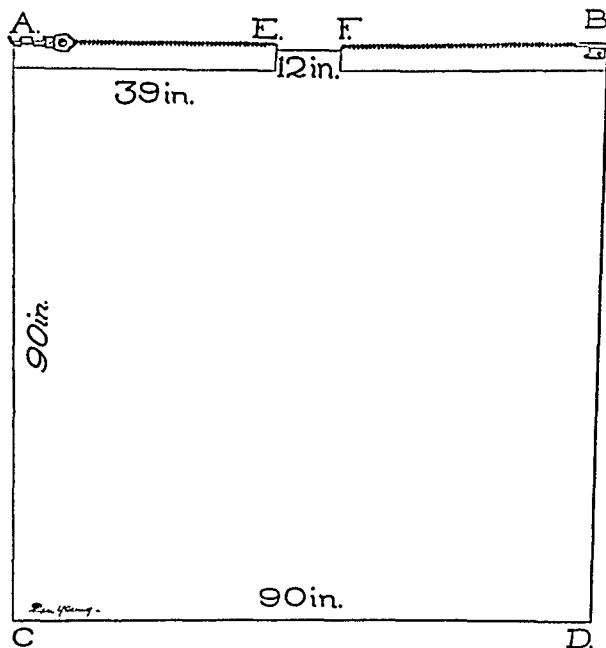


FIG. 1. Sheet showing dimensions.

head and the anesthetist by the use of sheets draped on metal hoops of various patterns. In the University Hospital we have used for several years a method of draping that has proved simple, convenient and practical and that offers certain advantages over the usual methods.

The unique feature of this method lies in the use of a sheet 90 in. square, on one side of which are sewed talon fasteners with the eye and lock at one corner and the thread end at the opposite corner, leaving a gap between the fasteners of 12 in., which will pass around the neck (Fig. 1). The talon fasteners are similar to the fastener used on the zipper bags, etc. and come attached to a narrow strip of stout cloth which can be sewed to the usual operating-room sheets. The sheet is folded on itself as shown in Figure 2. In order to reduce it to a compact package suitable for steriliza-

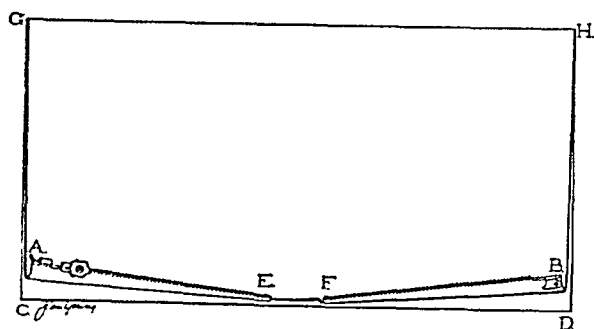


FIG. 2. First fold.

tion and storing, it is folded once again in the same direction, bringing points g to c and h to d, thus leaving the "zipper" border up. The sides are now folded in accordion pleats toward the center. It can now be wrapped or placed in drums for sterilization. When ready for use, the patient is placed on the table, two sterile towels are placed under his head, the neck and lower face prepared by any desired antiseptic, the upper towel is lifted by the anesthetist and clamped over the forehead to cover the hair and make a cap. The head is now lifted and the sheet folded as in Figure 2, passed under the head, between the towels until the neck lies in the space EF. Points A and B are now lifted up to meet each other above the patient's head, the sheet being kept taut while c and d are dropped to meet the body draping. The fasteners are engaged and by pulling the button to points EF as shown in Figure 3 the upper half of the sheet becomes a wall separating the anesthetist and the patient's head from the operator and his field. The opening for the neck is best left smaller than the patient's neck since the button as it is pulled down can be locked at any desired point when the sheet is snugly around the neck. The upper portion of the drape falls closely over the patient's head and the anesthetist as shown in Figure 4. This gives the operator every

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opportunity to work from the side. Retraction can be used in any direction and the range of movement and activity of both

the usual laundry since there is danger of crushing the fastener, but have been laundered without being put through the

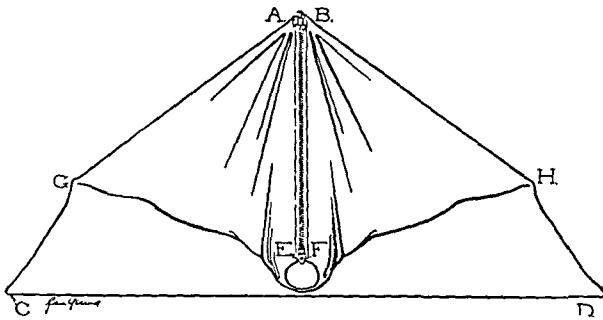


FIG. 3. Final position, without patient, viewed from side of operative field.

operator and assistants is far greater than when using the stiff metal hoop. The actual time used in applying the drape is only a few seconds after familiarity is established.

The talon fastener has been used only during the past four months prior to which time a series of small clips or safety pins were used. These were entirely satisfactory but were not as convenient as the present modification. The metal fasteners as now used have stood up under use in a surprising manner, some of them having been used fifty times without showing any defect. They have not been sent through

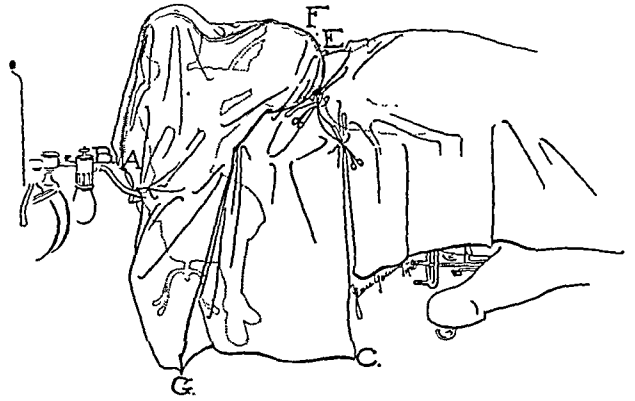


FIG. 4. Side view of complete draping.

mangle. The fasteners are not expensive and with the use we have had of them up to the present, their cost now is only a few cents for each operation. If one does not wish to use the metal fastener the method remains the same by using a series of safety pins from points AB to EF.

This method of draping is reported because it is simple, efficient and increases the ease of operation by giving greater freedom of action, by adding another direction in which traction and other manipulation can be carried out.



# PNEUMOCOCCUS PERITONITIS\*

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**P**NEUMOCOCCUS peritonitis is uncommon. For example, at Lenox Hill Hospital, which has 350 beds, there have been but 10 cases within the past five years. This is an average of only 2 cases a year. Inasmuch as practically all patients suffering with pneumococcus peritonitis are referred to a hospital, these figures are a fair indication of the rarity of the disease.

Despite the relative infrequency of this ailment I decided to study it because textbooks and journals have devoted such little space to it. I was further interested in this condition since, at the present time, there is no unanimity of opinion concerning the etiology and the treatment, questions of great importance because of the high mortality in pneumococcus peritonitis.

The history of pneumococcus peritonitis, at least of its chronic form, dates back to before the discovery of the pneumococcus. Since the middle of the 19th century cases of peritonitis which were undoubtedly of pneumococcic origin have been described in the literature, especially in the French journals. However, only since 1890 with the advent of asepsis and the resulting increase of laparotomies, has the pneumococcus been recognized as the causative agent of many of the cases until then termed "cryptogenetic" or "idiopathic" peritonitis. The first comprehensive works on this subject are those of Michaut (1901), von Brunn (1903) and Jenssen (1903). In America, interest in pneumococcus peritonitis was dormant until recently. Only within the past ten years has there been any thorough investigation of this subject.

The disease has a predilection for children up to the age of fourteen. The incidence is greater in girls than in boys. The proportions are variously reported,

but the average is about five to one. Some authorities claim even higher figures. The cases are generally seen in children of the poorer classes. Occasionally adults are stricken with pneumococcus peritonitis, and among these the males and females are about evenly divided. The onset is generally acute. Only rarely is there a prodromal period of one or two days in which the patient complains of general malaise and occasionally of cough or a gastrointestinal upset. Pneumococcus peritonitis in conjunction with a lobar pneumonia is reported in only single instances. Much more frequently there are references to a preceding bronchitis or tonsillitis.

As already stated, the onset is usually acute. The disease starts suddenly with nausea, vomiting and severe abdominal pains. The temperature is high. Constipation is the exception, diarrhea the rule. The latter can almost be considered pathognomonic. There is frequency of urination. The general condition is fairly good at the onset. This is the more remarkable since the mortality is very high in this stage. It is most probably explained by the absence of the "facies abdominalis" which one is accustomed to see in severe cases of peritonitis. Instead of this, cyanosis of the face, especially of the lips, is noted and is frequently associated with a herpes labialis. The pulse is good at least during the early stages. This is also noteworthy, as we usually expect a poor pulse in generalized peritonitis. An early diagnosis of generalized peritonitis is obvious. There is tenderness over the entire abdomen, with rigidity of the muscles. This latter is not as marked, however, as in a case of perforated appendicitis. The abdomen is comparatively softer, less resistant and feels somewhat "doughy." The blood count is high, frequently show-

\* From the Surgical Service of Dr. Carl Eggers of the Lenox Hill Hospital. Submitted for publication September 25, 1929.

ing a leucocytosis of 30,000, with a polymorphocytosis of 80-90 per cent. A positive pneumococcus blood culture is common according to the reports. Pneumococci can also be recovered from the spinal fluid.

This is the typical picture as it is most commonly seen in children. There are, however, other rare forms, in which the course is more chronic. Still others develop a bronchitis or a pneumonia in the early days of the illness.

The acute stage either ends in death in a few days, usually three to four, or, in unfortunately but a few of the cases, enters the chronic stage. The temperature falls. The patient gives the impression of having overcome the systemic infection. Vomiting and diarrhea cease. Abdominal tenderness is less. After about ten days, sometimes sooner, sometimes later, the temperature again begins to rise. The abdominal circumference increases and palpation discloses fluctuation with the formation of an exudate which later develops into an abscess sometimes reaching considerable size. This abscess either leads to death with the picture of a marked cachexia, or it breaks through the abdominal wall, most commonly at the umbilicus. This umbilical abscess and perforation were described as a typical clinical entity long before the advent of asepsis. And even with drainage, such an abscess can occasionally form metastatic foci elsewhere, for example in the bones or joints, from which foci pneumococci can be recovered.

I will now summarize the 10 cases of pneumococcus peritonitis that have occurred within the past five years at Lenox Hill Hospital. There were 8 children and 2 adults. Of the children 7 were girls and 1 was a boy. It was interesting to note that 6 of the children gave histories of having had whooping cough at some time before their present illnesses. Similar observations have been reported by others. With the exception of one case none of the 8 children had a cough before the onset of the abdominal pain. The pain started

suddenly in all 8 cases. In one case there had been a similar mild attack one month before. Examination of the lungs revealed signs suggestive of bronchopneumonia in 5 of the cases on the day of admission, which would mean about one or two days after the actual onset of the illness. The examination of the other 3 cases showed no lung changes. Seven of these cases were operated upon on the day of admission, and an abdominal puncture was done in the case of the other child on the day following admission. In all the cases operated upon, the appendix was removed, and in one case the right tube as well. Pneumococci were found in the abdominal pus of all the cases, and all four types were represented in the series. In only one case was a blood culture and a spinal fluid culture done, both of which showed pneumococci. Six of the 8 cases died, among them being the case in which only an abdominal puncture had been done, and also one case which had received pneumococcus serum. Both of the cases that recovered showed a tendency towards chronicity from the start. One of these cases was the boy, and the other was one which later developed metastatic foci in which pneumococci were demonstrated.

Both of the adults were women. The first patient was thirty-three years old. She was admitted with a beginning peritonitis following abortion. The blood culture showed pneumococci. This patient was not operated upon, but was treated with pneumococcus serum. She survived. The other case was a private patient of Dr. Carl Eggers. The patient, twenty-three years old, was suddenly seized with abdominal pain thirty-six hours before admission to the hospital. The lungs showed no changes. The abdomen showed the picture of generalized peritonitis with tenderness more marked on the right than on the left. A diagnosis of a ruptured appendix was made. At operation, free pus coming from a bilateral pyosalpinx was found in the peritoneal cavity. Both tubes and the appendix were removed. The



pathological report showed that both tubes were open at their fimbriated ends. Pneumococci were demonstrated in the pus from the right tube. The pus from the left tube and from the peritoneal cavity were sterile.

The diagnosis of pneumococcus peritonitis is of practical importance, because as we will see later there is no unanimity of opinion as to whether operation is indicated or contraindicated. Certainly, in many of the cases, especially in adults, it is impossible to differentiate between generalized peritonitis and pneumococcus peritonitis. However, in children, particularly in girls, the symptomatology is sufficiently clear-cut to make a diagnosis of pneumococcus peritonitis if one but keeps this condition in mind. The clinching of the diagnosis is, of course, only possible through the isolation of pneumococci from the blood stream or from fluid obtained by abdominal puncture. And this proof must be obtained as quickly as possible, for delay in making the differential diagnosis, for example of a perforated appendix in which every hour counts, may lead to the death of the patient. Other conditions which must be differentiated are gonorrheal peritonitis and abdominal typhoid. Neither of these, however, has such an acute onset as to necessitate immediate operation. Streptococcus peritonitis must also be considered, but it is even more rare than pneumococcus peritonitis. In fact the opinion has been voiced not infrequently that cases of streptococcus peritonitis described in the literature really were of pneumococcal origin, since it is at times very difficult to differentiate streptococci and pneumococci culturally. In the chronic cases, there may be difficulty in differentiating it from an appendiceal abscess and from tuberculous peritonitis. However, a mistaken diagnosis is not of such importance in those cases. An abscess, whether it be an appendiceal or a pneumococcus abscess, must be opened. And in tuberculous

peritonitis, a laparotomy is good therapy anyway.

#### ETIOLOGY

There are many divergent opinions as to the etiology. Pneumococcus peritonitis is generally regarded as either primary or secondary. This differentiation does not seem very rational to me, for in calling a case primary, one merely admits that one does not know in which way the peritoneum was infected. It is therefore but a term of convenience.

There are three possible ways for bacteria to enter the peritoneum. The first is via the intestines, the second via the genital apparatus, and the third via the blood or lymph streams.

The intestines have been considered as the portal of entry in this infection, because sputum is swallowed, especially by children, and in this way the organisms might wander through the enteric walls. Jenssen in some interesting experiments demonstrated pneumococci in the intestinal wall of mice that had been fed cultures of pneumococci. However, he did not produce a peritonitis. Wolfsohn repeated this experiment. Several of his animals developed a sepsis, but not a peritonitis. On the other hand, other researches failed to produce any pathological changes in the animals fed on pneumococci. On the basis of this work, it is fair to assume that a pneumococcus peritonitis cannot result from infection from the gastrointestinal tract.

Since the incidence of this illness is greater in girls, our attention is focused on the female genital organs as a possible port of entry. Is it not likely that the organisms may travel up the Fallopian tubes as they do in gonorrheal peritonitis? This view is supported by the observation that in many cases the infection commences in the pelvis minor. Furthermore, cases have been reported in which the peritonitis followed either abortion or childbirth. The 2 adult cases described also seemed to indicate an ascending type of

infection. Koennecke is of the opinion that the pneumococci swallowed by children with their sputum reach the genitals by way of the anus. Actually, pneumococci are frequently found on vaginal smear.

Whether or not these findings are positive proof is doubtful, for pneumococci are also found in the vaginal smears taken from perfectly healthy women. The organisms in these instances are not virulent however, and exist in symbiosis with other forms of bacteria. Besides pneumococci can be cultured from the urine of women suffering with pneumococcus peritonitis. It is therefore not at all certain that in primary pneumococcus peritonitis, vaginitis precedes the peritonitis. Furthermore, since pneumococcus peritonitis occurs in women who have had a complete extirpation of their genital organs and also in pregnant women, and since it occurs with the same clinical picture in men, the portal of entry must of necessity be other than through the female genital organs.

We have seen that pneumococcus peritonitis begins not only as a general toxemia, but that in many cases we have also been able to culture the organism from the blood stream. Does not, therefore, the thought of a hematogenous infection with the primary portal of entry in the upper respiratory passages or tonsils seem much more plausible? This is comparable to many instances of generalized sepsis with metastatic foci. Pneumococcus peritonitis can also be considered a metastatic manifestation of a general pneumococcus septiemia. The report of Schmidt in 1911 lends further support to this contention. He reported a large series of cases of pneumococcus peritonitis following an epidemic of an infection similar to grippe. It is well known that a peritonitis and a pneumonia are frequently confused in children. Is it not reasonable to assume that these are cases of a bacteremia with a transient irritation of the peritoneum? The question has also been raised as to whether the infection might not also be carried

by the lymphatics. However, that hardly seems possible, for the direction of lymph flow is from the abdomen to the thorax and not reversed.

Of course, in accepting the idea of a hematogenous portal of entry, one must consider the experiments of Jensen in which he recovered pneumococci from the blood stream of animals within a few minutes after injecting the organisms into their peritoneal cavities. However, this theory does not explain why girls are so much more commonly stricken than boys. An attempt has been made to explain this on a basis of lessened resistance on the part of the female peritoneum to pneumococci in a similar way as we explain the hematogenous infection of the peritoneum on a basis of lessened resistance. Vollhard and others have strengthened this view with cases of nephroses with ascites in which a pneumococcus peritonitis developed as a result of an already damaged peritoneum.

To summarize briefly the above, it is my impression that the large majority of the cases, especially those occurring in children, are based on hematogenous origin, and that only occasional cases, usually in adult women, are based on ascending infection of the female genital tract.

#### PATHOLOGICAL AND ANATOMICAL FINDINGS

Early in the disease there are inflamed distended loops of gut with a cloudy exudate which soon becomes mucopurulent and which is odorless. This pus has the tendency to form fibrinous strands, a sort of pseudomembrane just as we are accustomed to see in pneumococcus empyemas. These membranes soon tend to wall off the purulent exudate. The resulting abscesses are often immense and often fill the entire abdomen, pushing the matted loops of intestines backward toward the spinal column.

#### MORTALITY

The mortality in this disease is unusually high. Those cases that are operated upon

in their early stages show a mortality of 80 to 90 per cent according to the figures of Jenssen, von Brunn, Rohr and Budde. Koennecke's figures are somewhat more reassuring, showing a mortality of about 50 per cent in a series of 27 cases. Of course, the differentiation of the two forms of peritonitis varies, and the transition between the diffuse and the encapsulated forms is gradual so that this may explain the discrepancy in the mortality figures of the different men. The prognosis in the chronic form is naturally better. The mortality in operated cases of this type is only about 10 per cent. There are unfortunately no statistics for unoperated cases. Our interest, therefore, lies chiefly in the diffuse forms that either were not operated upon at all, or were operated upon later in the stage of encapsulation. In the past few years there have been a large series of cases reported in which expectant treatment was used with good results.

#### TREATMENT

There can be no question concerning the treatment in those cases in which an abscess has formed. An abscess must be incised and drained. In a transitional case, that is, in a case where the early diffuse stage has been survived, but in which the encapsulation and abscess formation has not been complete, it is better to wait so as not to destroy any adhesions which have already been formed. Budde has shown that the mortality during this period, which he considers as being from the fourth to the tenth day, is considerably less than in the early stages.

The only question about which there can be any doubt is what to do in the early stages. As already stated, the mortality in the cases operated upon during the first days is 90 per cent. Surely the mortality of the non-operated cases cannot be higher. We may, at least, assume that some of the cases described in the literature as operated upon during the transitional and chronic stages must have passed through an acute stage. Because of the

high mortality of operation in early cases, the consensus of opinion in the past few years has swung towards waiting in these cases. American surgeons were the first to express this opinion (Kahn, Meredith, Syms, Lilienthal, Beavan, Marshall), but there are now also in Germany a large number of surgeons (Strauss, Remijnse, Budde, Salzer) who condemn early operation. They all point out that one form of peritonitis, namely gonorrheal peritonitis, has been successfully treated for a long time by conservative waiting. This form of peritonitis, however, is not a generalized one. It is their contention that early operation in pneumococcus peritonitis is contraindicated because in its early stages it is a systemic generalized infection and operative interference can do more harm than good. It is better to let the body fight off the invading organisms unmolested, and to aid and conserve this resistance with conservative measures. Most of the surgeons who favor early operation do so because of their difficulty in diagnosing this condition. And that, of course, is the determining factor. It is not always possible to make a positive diagnosis of pneumococcus peritonitis, because due to the urgency of the case, one cannot usually wait for a positive culture. One has to content oneself with a smear of the pus obtained through abdominal puncture, and attempt to find pneumococci in this smear. Neuhof and Cohen have published a series of 100 peritonitis cases in which they found the exciting organism through abdominal puncture without any instance of the dreaded complication of puncturing the intestines. If one should decide on an operation, the purpose should be merely to drain the peritoneum. The question of irrigating the abdomen has not been settled. Irrigations with saline, ether, diluted bile, optochin and rivanol have been tried, but without any noteworthy effect. It is questionable whether such irrigations are of value, because adhesions already formed may be destroyed by them. Drainage through the abdominal incision

seems rational, although some surgeons close up without draining. Still others drain through the vagina. This method strikes me as being a particularly good one as it is well known that a colpotomy alone is associated with but little shock to the patient. The sepsis has been treated with optochin, horse serum, autogenous blood and pneumococcus serum injections. The latter serum should be more widely used in early cases and in those caused by the type of pneumococcus against which the serum is specific. We treated 2 cases in such manner. The first, which

had a diffuse peritonitis and was operated upon, died. The second, a chronic peritonitis not operated upon, was cured.

#### CONCLUSION

We can reduce the appallingly high mortality figures of pneumococcus peritonitis by not operating in the acute diffuse forms, but by treating them expectantly. We can do this because we are in a position today to definitely establish the diagnosis of pneumococcus peritonitis in many of the cases.

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# AMEBIC DYSENTERY

## ITS OCCURRENCE IN ROUTINE SURGICAL PRACTICE\*

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WITHIN the last two years in the course of a routine surgical practice we have detected 7 cases of amebic dysentery, all diagnosed by sigmoidoscopic examinations and confirmed by positive cytological identification by Dr. Sheplar. It is rather interesting to note that the 7 cases were all in ambulatory patients presenting symptoms of large bowel disturbances and occurred, with two exceptions, in patients who had permanently resided in the neighborhood of New York City. In the preceding eight years only 2 similar cases were identified under similar circumstances. There are perhaps two explanations for this apparent large increase in incidence of amebic dysentery in our own practice: first, an absolute increase in the general population frequency of amebiasis and secondly, as a result of detecting the earlier cases we have naturally been on the lookout for other cases. It is a regular and routine procedure to do a sigmoidoscopic examination upon all patients with any symptoms of bowel trouble. The symptomatology and the history of patients with amebic dysentery is, as a rule, distinctive and the sigmoidoscopic appearance of the lower bowel quite characteristic. The case histories are herewith given briefly and chronologically:

CASE I. C. M., female, married, aged thirty-eight, Saleslady. Complaint: diarrhea, cramps, passing of blood by rectum, loss of weight, anemia. Always resided in New York but made frequent trips to Illinois and Iowa. Duration of symptoms, six months. Diagnosis: subacute amebic dysentery.

CASE II. E. C., male, married, aged forty-six, Journalist. Complaint: general abdominal cramps, lack of strength, occasional blood in

stools, loss of weight. Always resided in California until recently. Duration of symptoms, eighteen months. Diagnosis: chronic amebic dysentery.

CASE III. R. C., male, aged fifteen, school-boy. Complaint: abdominal pain, diarrhea, with blood and mucus, rapid loss of weight and strength. Resided in New York until recently when patient went to a school in Tennessee. Duration of symptoms, four weeks. Diagnosis, acute amebic dysentery.

CASE IV. L. J., male, aged twenty-four, single, life guard. Complaint: passing of blood, diarrhea, indigestion, abdominal pain and gas. Always resided on Long Island; never been outside of New York State. Duration of symptoms, three months. Diagnosis, subacute amebic dysentery.

CASE V. C. D., male, aged forty-two, married, credit clerk. Complaint: diarrhea and passing of blood. Resides in New Jersey, commutes to New York. Duration of symptoms, two weeks. Diagnosis, acute amebic dysentery.

CASE VI. M. O., male, aged forty-eight, married, stableman. Complaint: pain, bloody diarrhea. Born in Hungary; resided in New York for the past fourteen years. Duration of symptoms, over one year. Diagnosis, chronic amebic dysentery.

CASE VII. W. H., aged thirty-four, married, dentist. Complaint: intermittent attacks of diarrhea, with bleeding; loss of weight, color and strength. Always resided in New York. Duration of symptoms, eight years. Diagnosis, chronic amebic dysentery.

The 7 patients comprise 1 female and 6 males; the youngest is fifteen years of age, and the oldest forty-eight years of age. Only two had ever been south of the Mason and Dixon line; the female patient, a travelling saleswoman, had made frequent excursions to Illinois and

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Iowa. All were native born with one exception, a Hungarian, and the social status of all the patients was, with one exception, slightly above the average. It is reasonable to suppose that at least five of these cases, occurring in Long Island, New Jersey, Pennsylvania and New York City, became infested in their local environment. The youngest patient was probably infected at school in Tennessee. In the Hungarian patient the source is doubtful. All of these patients were ambulatory when they came to my office. A progressive loss of weight, fatigue and some degree of anemia, with attacks of diarrhea, abdominal pain and tenderness in the lower half of the abdomen, associated with the passage of blood and mucus, were present in some degree in all the cases. Even in this small group of cases an acute and chronic symptomatology is readily apparent. Cases III, IV and V were evidently acute manifestations. In these pain was a prominent symptom, with frequent stools at night, with the passage of considerable blood and mucus in the stools.

The other cases were more chronic, with less pain, fewer stools, less blood and mucus, but with a greater anemia, cachexia and loss of weight. A tentative diagnosis of amebic dysentery was made in all of them upon sigmoidoscopic examination. A fresh warm specimen, obtained through the sigmoidoscope by swabbing the ulcerated areas, showed *Ameba histolytica* with ingested erythrocytes in 6 of the 7 cases on the first examination. The one exception showed the encysted form of ameba with cells containing four nuclei. This is a higher percentage of positive findings on the first examination than usually obtains in examining the fresh warm stool.

James, from a very great experience, found that one examination of the fresh warm stool detected a third of the cases; three examinations, one-half to two-thirds, and six examinations 90 per cent of the cases.

In amebic dysentery there are appar-

ently three clinical groups: (1) those actively infested cases consulting a physician for relief during an acute infestation, or an acute exacerbation of a chronic infestation; (2) those latent or mild symptom-producing cases without very manifest trouble but with occasional diarrheic attacks with considerable mucus, rarely blood; (3) those supposedly intact, apparently non-infested symptomless carriers.

Craig from an unusually extensive experience believes that 10 per cent of the entire population are infected and makes the distinction between amebiasis or amebic infection and amebic dysentery. He believes that 50 per cent of the so-called carriers actually have symptoms in the way of general debility, cachexia, anemia and with a variety of arthritis.

*Entameba histolytica* being a true parasite invades the tissue of the host and theoretically at least there are always lesions in the supposedly symptom-free carrier. Musgrave demonstrated that macroscopic ulcers of the colon may be present without diarrhea and MacNeal showed abundant ameba in the submucous layer of the intestine at the site of the ulcers and within the lumen of the veins and lymphatics. The carriers far outnumber the individuals who have symptoms of the disease. Musser states that 95 per cent of those infested with amebae are carriers. "Symptoms depend upon resistance of the host rather than upon the virulence of the parasite." Dobell and Low classify the general aspect of amebic infection or infestation into the following clinical groups: (1) general amebiasis; (2) amebic diarrhea; (3) amebic dysentery; (4) carriers.

There is only one generally recognized cause of amebic dysentery and that is infection with *Entameba dysenteriae*, or *Entameba histolytica* as it is called in the newer books. However, there are a number of forms of harmless amebae that may be present in the intestinal tract of man, the most common of which are *Entameba coli*, *Endolimax mana*, *Ioda-*

meba bütschlii and *Dientameba fragilis*. These amebae do not seem to be associated with amebic dysentery in man or with its serious complication, liver abscess, according to Stitt.<sup>1</sup> The only importance then attached to these amebae is that they at times have to be differentiated from the pathogenic *Entameba histolytica*. Each of these types of amebae may be present in the stools in two forms: the encysted, which is non-motile, and the vegetative, which is motile. The vegetative form is more easily recognized on account of its change in shape and movements and is the form searched for in the stools of suspected amebic dysentery. The encysted form of the *Entameba histolytica* is present in the stools of the carriers and the convalescent. Cysts are present usually in very small numbers and the various types are differentiated by the number of nuclei, special staining methods being necessary to demonstrate them.

Infection takes place only through ingestion of the cysts, the vegetative state being considered non-infectious. The small number of cysts present in stools accounts for the fact that this type of dysentery exists only in endemic form. If the vegetative form were able to infect, there would be epidemics of amebic dysentery similar to those of bacillary dysentery. Contaminated food is the only source of infection in the temperate zone, the contamination occurring through food handling by a carrier of unclean habits who harbors *entameba histolytica* cysts in the intestines. The vegetative amebae soon undergo disintegration after being passed from the body. Vigorous emetine treatment may prevent the formation of cysts which develop only within the body.

The pathological effect of amebae is usually limited to the large intestine and begins as an acute catarrhal inflammation with the production of mucus; in chronic cases vast quantities of mucus may be formed, so that the stool seems to be composed of nothing but mucus. Amebae

invade the crypts of the mucosa, producing little elevations or nodules with a central plug of yellowish necrotic material. When this sloughs off small ulcers are revealed which may be very minute. The ulcers may coalesce producing large ones with elevated ragged undermined edges. Between the ulcers the mucosa may be thickened and inflamed. Ulcers of all sizes may be present.

Examinations for amebae are made on warm stools passed after taking a saline purgative, preferably magnesium sulphate. Purgatives are considered essential by some workers but are said to increase the difficulty of differentiating between different kinds of amebae. The vegetative forms are readily seen in a thin wet preparation by the low-power objective, because of their highly refractile protoplasm and its bluish tinge. If cells of this type are found they are next examined by a higher magnification. Living amebae show change of form and a flowing-out of finger-like processes and at times slow progressive movement. It is extremely difficult to differentiate the vegetative forms of the various types of amebae and the only real basis upon which the differentiation can be made is the finding of ingested red blood cells within the amebae. Non-pathogenic forms do not engulf red blood cells. Not all stools containing *Entameba histolytica* show this picture. Therefore some other way must be found to distinguish between pathogenic and non-pathogenic types. This can be done by staining film preparations of the stool containing amebae and studying the nucleus. But this is not a simple procedure and the staining in the hands of the inexpert is not always successful, the nucleus being so overstained that its recognition is impossible.

During the past two years we have had submitted for examination material taken directly from ulcers through a proctoscope. Mucus thus obtained was rich in amebae, many of which were filled with red blood cells. In some of these cases examinations were made on material ob-

<sup>1</sup> 1927 Edition.

tained by both methods, that is stools after a saline cathartic, and on mucus obtained from the lower bowel. In several instances the first method yielded vegetative amebae containing no red blood cells while the second method on the same patient showed many blood-engorged amebae. This quick dependable accurate method saves interminable hours of the patient's time spent in the laboratory in production of stools and likewise much of the laboratory worker's time spent in the fruitless search of innumerable preparations for amebae that may not be present, or, if present, not easily recognized as *Entamebae histolytica*. In the busy days of a modern laboratory this shortening of time spent in the diagnosis cannot be too highly appreciated. This proctoscopic method results not only in a saving of time but also in greater precision of diagnosis. The procedure herein described is not new but it is one that is not employed as frequently as it should be.

Our procedure has been to have the patient take a small saline enema about 7 A.M. to clear only the rectum. Without any further preparation the patient presents himself for sigmoidoscopic examination. The introduction of the proctoscope or sigmoidoscope has usually been without pain. It has been inserted anywhere from 10 to 14 inches. At about the sigmoidal-rectal junction one finds an area not unlike a ruptured urticarial bleb. The erosion of the rectal mucosa is without elevation, the edges are irregular, with a bright pink-red base which bleeds readily. Sur-

rounding and lying in this ulcer is a plaque or a number of drops of tenacious mucus. Of striking appearance is the normal mucous membrane between the ulcerated areas. The ulcers are irregularly distributed, and in our experience, have been 1 to 1.5 cm. in diameter. Upon swabbing the ulcer the overlying mucus is detached and when applied to a warm slide active amebae were readily obtained.

#### CONCLUSIONS

1. A considerable percentage of the population in all the geographical areas of the United States are probably infested with *Ameba histolytica*.

2. The majority so infected are probably relatively free from symptoms, but the supposed symptomless carriers frequently show conditions of impoverished health, or arthritis.

3. When the intestinal infestations: amebic dysentery or amebic diarrhea, produce symptoms, the history and symptomatology is distinctive and clear cut.

4. There are characteristic lesions in the upper rectum and lower sigmoid that can be visualized by proctoscopic examination.

5. The removal of the mucous plug through a proctoscope from an ulcerated area has, in our hands, proved about the most effective way of obtaining the vegetative amebae.

6. Every patient giving a history of frequent stools, mucus and blood, should be examined with the idea of an amebic infestation.





# TRAUMATIC INJURIES TO THE PANCREAS\*

## REPORT OF CASE: RECOVERY

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**T**RAUMATIC injuries to the pancreas may be either *subcutaneous*, *penetrating*, or *operative*.

*Subcutaneous injuries* result from direct or indirect forces applied to the front, side, or back of the trunk. (Fig. 1.)

*Penetrating injuries* result from bullets, knife wounds, or other penetrating forces.

The pancreas may be injured during the following *operative* procedures: gall-bladder operations, retroduodenal palpation for stones in the common duct, incision for pancreatic calculi, diagnostic biopsy of the pancreas, subtotal gastric resection for ulcer of the duodenum, splenectomy, and nephrectomy of the right kidney.

### INCIDENCE

Traumatic pancreatitis, in which the pancreas is the *only* organ originally injured, is an exceptionally rare condition. A survey of the medical literature reveals but a very few cases. This treatise reviews the literature, and gives the account of a most unusual and extremely rare case of injury to the pancreas which recovered following four major operations.

Trauma to the pancreas may cause any of the following pathological conditions: contusion of the pancreas, rupture of the pancreas, acute traumatic hemorrhagic pancreatitis, pancreatic apoplexy due to injury, necrosis or abscess of the pancreas, gangrene of the pancreas, pseudo-cyst of the pancreas, or chronic pancreatitis.

### REVIEW OF CASES REPORTED

The first case of injury to the pancreas was recorded in 1827, by Travers.<sup>2</sup> A drunken woman was thrown to the ground after violent contact with the wheel of a coach. She lived several days. At autopsy, a large intraperitoneal hemorrhage was

found. The liver was ruptured, and the pancreas torn completely across.

Garré<sup>3</sup> in 1905 was able to find only 30 recorded cases of injuries to the pancreas, and in only 8 was the pancreas the sole organ injured. Recovery occurred in 3 cases. Garré was the first to cure a case of isolated rupture of the pancreas by suturing.

Von Mikulicz<sup>4</sup> in 1903 collected the records of 45 cases of pancreatic injury. There were 21 cases of penetrating wounds, and 24 cases of subcutaneous wounds resulting from blunt force. Of the 21 cases from penetrating wounds, 12 were due to gunshot, and 9 to stab wounds. Five of the 12 cases of gunshot wounds were operated upon and 3 recovered; the other 7 were not operated upon and all died. The 3 successful cases were recorded by Otis,<sup>5</sup> Hahn,<sup>6</sup> and Ninni.<sup>7</sup> In 7 of the 9 stab wounds, the pancreas was in part prolapsed. In 2 it was replaced; in 5 it was sutured or ligated and replaced; all these patients recovered. In only 2 of the 9 stab wounds was there intra-abdominal injury of the pancreas, Kuttner<sup>8</sup> and Hildebrand.<sup>9</sup>

Of the 24 subcutaneous injuries, 13 patients were not operated upon and all died; 11 were operated upon and 7 recovered. The operation consisted of exposure of the pancreas and drainage.

Cowen<sup>10</sup> in 1907 reported a case of subcutaneous injury to the pancreas. The patient was admitted to the hospital with a history of a fall upon the abdomen, four days previously. During these four days he had great pain in the upper abdomen and back, continuous with paroxysmal exacerbations. At operation the lesser sac was distended with large amounts of blood-stained fluid. The patient was left with a sinus discharging 6 to 8 oz.

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of clear fluid a day, which fluid was most irritating to the skin, and causing a very painful dermatitis. In rupture of the

a rupture of the pancreas, dividing it into two nearly equal portions, was found and there was fat necrosis in the neighbor-

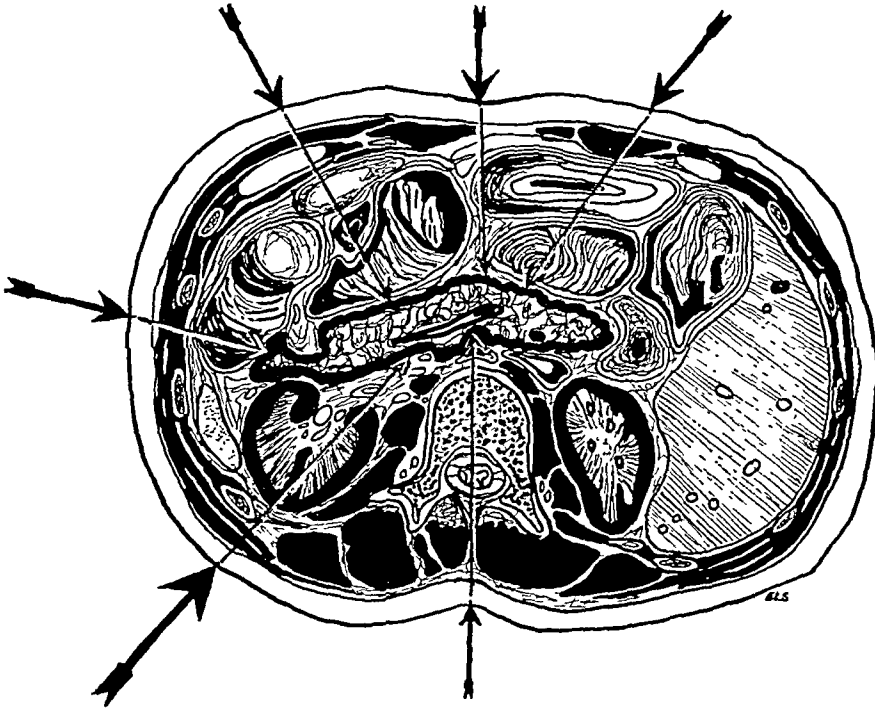


FIG. 1. Cross section showing how forceps applied to front, side and back may injure pancreas.

pancreas, much depends on the condition of the canal of Wirsung. This is sometimes intact although section of the gland appears complete (Leith<sup>11</sup>). It is sometimes severed, as in this case, and a copious discharge of pancreatic secretion is observed if the patient survives a few days (Schmidt<sup>12</sup>).

In a fatal case recorded by Wilks and Noxon<sup>13</sup> where the pancreas was so crushed opposite the spinal column as to be divided into two parts, the laceration was unaccompanied by any other abdominal injuries, and at the St. Bartholomew Hospital Museum there is a specimen taken from a patient at whose post mortem examination the pancreas was the only organ found to be injured. In this case the patient had been crushed between two vans and on admission only complained of slight pain in the epigastrium. Twenty-four hours later, he became collapsed, but recovered. Subsequently he vomited, became seriously collapsed, and died *three* days after receipt of the injury. At autopsy,

hood, but no injury of the duodenum, liver, spleen, kidneys, or other abdominal viscera.<sup>14</sup>

An injury of the pancreas that caused death on the *fourth* day was produced, in a case reported by Wagstaff,<sup>15</sup> by a fall from a cart on to the left side. At post-mortem examination the other abdominal organs were found to be uninjured.

A case seen by Robson and Cammidge<sup>14</sup> illustrates the serious results that may follow a comparatively *slight* blow over the region of the pancreas. A butler slipped and fell forward against a knifeboard projecting from the end of the table at which he was working. The blow was comparatively slight, and the man did not even fall to the ground. Traumatic pancreatitis followed on what was, at the beginning, probably a mere bruising of the pancreas. This was succeeded by slight bleeding into the gland, which effusion became infected. Acute hemorrhagic pancreatitis resulted. An exploration disclosed a large collection of fluid,

highly blood-stained, in the lesser peritoneal sac, some of which had burst through a small laceration in the omentum into the greater peritoneal sac. There was a general peritonitis present at the operation, and though drainage was freely adopted both from the front and the back, the patient did not survive many hours.

Wounds of the pancreas during *the late war* were extremely serious, and almost invariably fatal. Only one case observed by Moynihan recovered and remained well.<sup>16</sup> The pancreas was examined three years after the injury when an almost complete transverse rupture, healed, was found during an operation for the repair of a ventral hernia.

Hughes and Banks,<sup>17</sup> in their book on "War Surgery," quote only 1 case of recovery after injury to the pancreas.

In another class of injuries due to *crushes and blows*, although the pancreatic lesion is less severe than those just referred to, it is the main result of the injury, and slowly gives rise to symptoms that may be relieved by operation. After the shock of the accident has passed off, the patient may appear to have recovered, but in a longer or shorter time, varying from a few days to several weeks, an abdominal tumor appears, which on being explored, proves to be a distention of the lesser sac with blood-stained fluid. The first case of this kind was recorded by Kulenkampff,<sup>18</sup> and others have been reported by Senn,<sup>19</sup> Kuster,<sup>20</sup> and Karewski.<sup>21</sup> Cases following a blow have been recorded by Ross, Hadra,<sup>22</sup> Lloyd,<sup>23</sup> Randall,<sup>24</sup> Karewski,<sup>21</sup> and Robson and Cammidge.<sup>14</sup> Littlewood<sup>25</sup> described a case after a kick; W. H. Brown after a crush; and Cathcart and Sheen<sup>26</sup> after the patient had been run over.

The case of a man thirty-four years old, caught in a fall of earth, and sustaining a division in the midline of the pancreas, by vertical rupture, is recorded by Heineke.<sup>27</sup> The patient made a complete recovery.

Karewski<sup>21</sup> reports a case of a patient who had been run over after being struck in the abdomen by the shaft of a vehicle. He was able to walk home, but abdominal pain came on shortly afterwards, and an exploratory laparotomy was performed. There was a large quantity of free blood, especially in the region of the gastrocolic ligament, and the head of the pancreas was found to be crushed. The patient lost daily 400 gm. of pure pancreatic juice through the fistula. He lost weight, but the secretion diminished on a fatty anti-diabetic diet and the fistula was eventually closed.

Cases of bullet wounds of the pancreas have been described by Otis,<sup>5</sup> Sanitas, Bertram, Niemann, Borchard, von Brannmann, Hahn, Ninni, Simmonds, Korte, Mann-Slavsky, Carnell, Jephson, Becker and Kindt. Rarely the pancreas has been the only abdominal organ injured, but in the majority of instances other organs also have been involved in the injury. Penetrating wounds of the pancreas due to stabs or cuts with a knife or bayonet have been reported by Kleburg, Labordene, Caldwell, Dargan, and Kullner.

Cases in which inflammatory changes in the gland have resulted from injury have been recorded by Wandesleben,<sup>28</sup> Rolleston,<sup>29</sup> and others. In Rolleston's case, an abscess in the head of the pancreas with fat necrosis in the subperitoneal cavity was found at autopsy, eighty days after a blow in the abdomen. The blow had given rise to pain, vomiting, inaction of the bowels, and collapse simulating intestinal obstruction. Hansemann,<sup>30</sup> Fitz,<sup>31</sup> and Prince<sup>32</sup> have described cases of necrosis of the pancreas after injury.

In a case described by Mikulicz<sup>4</sup> a man was caught between two wagons. Eight days after the accident, the patient began to complain of pain and fullness in the epigastrium, vomited, and had dyspnea and a swelling in the upper part of the abdomen. Six days later, at laparotomy, two large cavities containing at least 6 quarts of red fluid were opened.

These cavities were in relation to the pancreas, and a fistula persisted for a while. Finally, four months later at autopsy, a scar 2 to 3 mm. was found at the tail of the pancreas. The patient succumbed to the inflammatory complications.

In the case of Kolaczek, a man was run over by a carriage which passed over his abdomen. The patient suffered immediate epigastric pain which gradually subsided during the following days. *Eight* days after the accident, the patient had severe pain in the epigastrium, with a tendency towards collapse, cold extremities, and a very weak and rapid pulse, and died. At the autopsy, a cavity the size of the head of a full term fetus was found in connection with the pancreas, communicating through an opening about 2 cm. in diameter above the transverse colon, with the general peritoneal cavity. This cavity contained 2 litres of blood-stained fluid. An oblique rupture of the pancreas was found.

These 2 cases of secondary hemorrhages occurred eight days after the accidents. Both had their origin in the substance of the pancreas or its blood supply. Both almost certainly were caused by the digestive action of the pancreatic juice on the walls of the blood vessels. The ferments of the pancreatic juice, principally the trypsin, are greatly responsible for the hemorrhages which frequently accompany rupture of the pancreas. The experience of Wells is very interesting on this subject. He found that it was the action of the trypsin on the walls of the blood vessels which caused secondary hemorrhages occurring about *a week* after the accidents. These are the hemorrhages which make one reserve opinion as to prognosis, when so-called simple accidents are followed by amelioration of symptoms, as in the case of Kolaczek.<sup>33</sup>

One hundred forty-five cases were tabulated recently by Schmieden and Sebening,<sup>1</sup> of pancreatic diseases following operation, as follows:

TYPE OF OPERATION	Cases
After stomach operation	91
After biliary operation	38
After splenectomy	7
After diagnostic excision of the pancreas	4
After other operations	5
Total	145

TYPE OF PANCREATIC DISEASE	Cases
Acute pancreatic necrosis	58
Purulent pancreatitis	15
Pancreatic abscess	10
Pancreatic fistula	18
Fat necrosis without any pancreatic change	3
Total	104

Of a total of 62 cases tabulated the following classification is recorded:

Sixty-two cases: 20 cured, 32 died.

	Cases
Blunt trauma	31
Gunshot injuries	26
Stab wounds	5
Injuries to the pancreas alone (14 cured, 6 died)	20
Transverse rupture (10 cured, 4 died, 3 died within 24 hrs. after injury; 1 was operated upon and died 16 days after operation)	14
Gunshot injuries (2 cured, 1 died)	3
Pressure injuries (2 cured)	2
Fragmentation (1 died)	1
Complicated pancreatic injuries (16 cured, 26 died)	42
Organs injured at the same time	
Stomach	19
Liver	13
Spleen	7
Bowel	8
Kidney	2
Aorta	1
Vena cava	1
Gall bladder	1
Common duct	1
Diaphragm	1
Lung	1

Traumatic pancreatitis occurs probably more often than is generally supposed.<sup>34</sup> In the most severe type of case, where there is a direct blow in the direction of the pancreas, there is usually such severe shock to the patient that immediate death results. Usually too, there are accompanying lesions such as ruptured liver, spleen, stomach or intestines. If the patient is operated upon immediately after such an injury, the surgeon's operat-

ing time is of course limited, and of necessity, the gross lesions are taken care of first. For this reason, the region of the pancreas is not thoroughly explored, and many cases of hemorrhage into the pancreas are thus overlooked.<sup>16</sup> At the other extreme there are cases where the trauma has been less severe, and although the pancreas may be injured, the symptoms of epigastric pain or pain in the back completely disappear after a short period of time. It is therefore conceivable that in these conditions the injury is less severe, or the pancreatic tissues more resistant, so that the reparative processes are uninterrupted. Between these two extremes, there are cases varying in intensity of symptoms and complications. Furthermore, the symptoms of pancreatic trauma are in no way characteristic, and an accurate diagnosis before operation is usually impossible.<sup>35,36</sup>

Fischer<sup>38</sup> in 1921, reported 40 cases observed in the literature of injuries to the pancreas, and gives the case reports of 30.

Of 9500 autopsies at the Pathological Institute of Leipzig in seven and one-half years, there was only one rupture of the pancreas.

#### ETIOLOGY

*Subcutaneous injuries* may result from blows sustained in fights, falls,<sup>14</sup> kicks, automobile or railroad collisions. It may occur from being run over, crushing between two vehicles, or from falling objects and cave-ins.

*Penetrating wounds* may be caused by bullets or pieces of shrapnel, knives, stiletos or other pointed penetrating objects. Usually in this type of case other organs are also injured. There is one case on record where the bullet pierced the lesser curvature of the stomach and only injured the pancreas.

The direction of the impinging force is usually from in front, but there are cases on record where the force has come from behind or from the side.

Wounds from sharp instruments and

firearms entering from without, and lacerations, even to complete rupture, from violent outside contusions that do not break the skin, are the traumatic injuries most apt to be sustained.<sup>35</sup>

The trauma, no matter how mild or severe, if impinging upon the region of the pancreas, may cause symptoms requiring immediate surgical intervention.

On the other hand, the reaction to the injured pancreas may be delayed, so that the inflammation and resulting symptoms may occur as the result of a slight injury at quite a remote date.<sup>40</sup> There may be absence of pain, and only the presence of a swelling in the epigastrium. This at operation may be found to be a blood tumor connected with the pancreas, a hematoma of, or a fluid effusion into the lesser peritoneal sac. All these symptoms can result from some trauma which happened a few days or weeks previous.

#### PATHOLOGY

The pathology of injuries to the pancreas varies with the degree of the trauma. The pancreas is so situated that its head and part of the body lie in front of the first and second lumbar vertebrae, the aorta and vena cava, while the rest of the body and tail extend to the left. In front is the stomach and intestines, while above is the liver, and to the left the spleen. Below are the kidneys, portal vein and the mid-colic artery. With the mildest form of external trauma, there may be no evidence of injury to the skin; the skin may not be bruised, and there may not even be ecchymoses. *But even with an absence of signs of external injury or violence, and notwithstanding what the initial trauma might have been, severe if not fatal damage might have been done.* The structure of the pancreas is such that a very insignificant trauma may result in a serious intraperitoneal hemorrhage.<sup>36</sup> Mild and moderate degrees of contusion of the pancreas cause rupture of the small and medium-sized blood vessels, and inflammation occurs as with the extravasation

of blood in any tissue. The pancreas is extremely vascular, being a glandular structure, supplying the digestive ferments trypsin, steapsin and amylopsin. It also supplies the internal secretion from the islands of Langerhans, which control carbohydrate metabolism. In mild degrees of contusion, the extravasation may be very slow, and it may take hours or days before the intraglandular tension ruptures its so-called capsule. Bosanquet and Clogg<sup>57</sup> state that extensive necrosis of the pancreas itself often results from hemorrhage alone. The nutrition of the gland is interfered with by the pressure of the extravasation within the capsule, and its tissues at the same time are torn up by the escaping blood. With more severe degrees of contusion, the hemorrhage is correspondingly greater, larger vessels are torn, and symptoms of shock and internal hemorrhage therefore manifest themselves within a shorter period of time. There may result extensive and perhaps fatal hemorrhage, or escape of juice with retroperitoneal hemorrhage and inflammation due to *bruising*.<sup>39</sup> The pancreas has been broken completely in two from a blow, leaving no external evidence of traumatism, and a person may even have a vehicle wheel pass over him causing his own spine to cut his pancreas in halves without the visible wounding of his skin.

Moquot and Constanti point out that in rupture or injury of the prevertebral portion of the pancreas, the gland alone is injured, as a rule; whereas in rupture of the left half of the gland, other visceral injuries are usually found.

The extravasated blood collects until the limits of the "capsule" are reached, and it is at this time that the tension on the "capsule" causes excruciating pain and shock. With the rupture of the "capsule," or with *initial* ruptures or penetrating wounds of the organ, there is an *immediate* flooding of the free peritoneal cavity, usually the lesser cavity, and retroperitoneal space along the posterior wall of the abdominal cavity. (Fig. 2.)

With *mild* contusion, the injury to the cellular structure of the gland and the rupture of the small capillaries and tubules

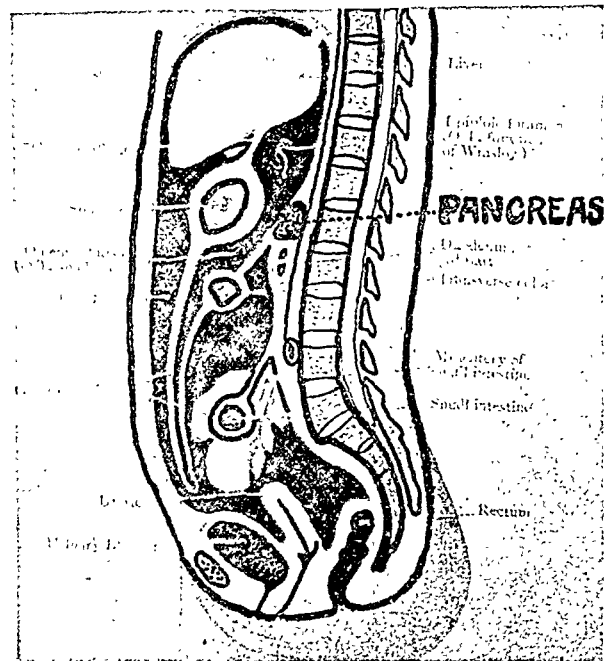


FIG. 2. Vertical section in midline.

containing digestive ferments cause an inflammatory reaction, the nature of which is peculiar to this gland. The digestive ferments, it is believed, cause further progressive change in the blood-vessel walls and glandular tissues, resulting in further hemorrhage and extension of the injury.<sup>41</sup> A further source of danger lies in the digestion by the pancreatic juice of the adhesions which the peritoneum produces. The outpouring of lymph is the chief means possessed by the peritoneum of protecting itself from harm; when the thick flakes of lymph are speedily digested by the pancreatic secretion, the avenue for further extension of the septic trouble is at once opened.<sup>16</sup>

Mikulicz points out the influence of the pancreatic ferments in cases of injury to the gland, and describes a vicious cycle, as follows:

Small hemorrhages, or disturbances in circulation; from this, necrosis of a small area of the gland; infiltration around this focus of the ferments set free by the destruction of the parenchyma cells; digestive changes in the

surrounding tissue and its vessels, which were until this time unchanged; enlargement of the hemorrhagic focus, partly as a direct result of the erosion of the vessels and partly as the result of the undermining of tissue and the increased pressure from the hematoma; necrosis and destruction of the surrounding parenchyma of the gland; further escape of the ferments, etc. The escape of the ferments of the pancreatic juice from the damaged portion of the gland is responsible for causing the characteristic signs of acute hemorrhagic pancreatitis, fat necrosis, localized peritonitis, and in the later stages, when infection is added, pancreatic abscess.<sup>43</sup>

It has been shown, both by experimental work and by observations made upon cases submitted to operation, that after the pancreas has been incised, bruised, or torn, its special secretion is poured out from the wound surfaces. The experimental work of Simon Flexner,<sup>44</sup> Biondi,<sup>45</sup> and Katz and Winkler<sup>46</sup> has shown that when the pancreas is so damaged, by injury however produced, its vitality is lowered, and there is an escape of the gland secretion into the parts around. This results in *fat necrosis* as well as active digestion of the tissues with which the juice comes in contact. An acute inflammation of the pancreas, with or without hemorrhage, or subacute or chronic pancreatitis may thus result. The digestion of the pancreatic juice freely poured out results, too, in the provision of an admirable culture material for any organisms that may chance to be present. An infection that the healthy peritoneum could certainly deal with becomes of the utmost virulence when an abundant food supply for the organisms is present. It is almost certain that in all abdominal operations some germs enter the peritoneal cavity. When their numbers are few, the *unharmed* peritoneum can resist them without difficulty, but if the natural powers of resistance of the peritoneum are greatly reduced, they may be competent to produce an acute inflammation with pus formation.<sup>16</sup>

Chiare and Pforringer also speak of self-digestive processes in the pancreas.

This disseminated fat necrosis, which Ponfic and others have observed and described, is most frequently seen in connection with hemorrhagic pancreatitis, gangrene and injury of the pancreas, and less often in suppurative inflammation.

The extravasated fluid and blood may collect in the lesser sac, and with the sealing off of the foramen of Winslow, may produce a blood tumor or *psuedo-cyst* of the pancreas. An injury may produce a *true cyst* of the pancreas, either from bruising and tearing of the duct causing stenosis and accumulation of secretion behind the point of injury, or the duct may be compressed and distorted by the scar tissue resulting from the injury to the neighboring gland substance.

There is a peculiar reaction excited when this fluid comes in contact with fat, be it in the omentum, or retroperitoneal spaces.<sup>60</sup> This reaction of digestive ferments on fat areas causes the so-called disseminated fat necroses. The steapsin of the pancreatic juice causes a digestion or breaking-down of the fat particles into glycerine and fatty acids, which with the calcium salts causes soap formation. Usually bunches of needle-shaped crystals of fatty acids are visible in these areas.<sup>43</sup> The combination with the calcium salts often produces in those situations the insoluble white calcium soaps, which add to the whiteness and opacity of the foci. In cases of acute hemorrhagic pancreatitis, they are very wide spread. In animals in which this condition has been produced experimentally, this condition is also found in the subcutaneous fat. These areas of fat necrosis contribute to the irritation and production of peritonitis.

The subsequent changes which might develop, depending upon the severity of the trauma, and the treatment instituted, are mere relative, progressive changes of the process just described. Abscess of the pancreas, either single or multilocular, gangrene and sloughing of the pancreas, either partial or total, are parts of the same disease entity.

Among the later or chronic results occurring from an initial *contusion* of the pancreas, are sclerosis and atrophy of the pancreas, chronic pancreatitis, diabetes, cyst or abscess of the pancreas, peripancreatic cyst, disturbances in the digestive functions of the gland, and pancreatic infantilism in adolescents.

With contusions of the pancreas, there is usually some accompanying injury to the neighboring viscera. The liver, spleen, kidney, stomach and intestines may be ruptured, contused or perforated. Injury to the spine and spinal cord are also possible accompaniments. Rupture of the duodenum, jejunum and transverse mesocolon have also been observed. The common bile duct appears always to have escaped, and the great vessels are rarely wounded. Guillemin<sup>51</sup> found a rupture of the coronary artery; Sencert<sup>52</sup> a division of the splenic artery; and Gulecke<sup>53</sup> a wound of both splenic and left renal artery.

The relation of the *solar plexus* to the pancreas and the injury to this plexus by the trauma explains the severe degree of shock and pain which accompanies lesions of the pancreas.

The addition of the element of *infection*, whether introduced from without at the time of the injury, or whether secondary, from direct extension from the gastrointestinal tract, adds a complicatory factor to the already complex condition initiated. By reason of the connection of the pancreatic ducts with the intestines, the injured pancreas is within easy access of an infected mucous membrane.<sup>48</sup> The easily decomposable substance of the pancreas only needs infection to become acutely dangerous. If infection does not take place, the injury may be repaired as in other organs.<sup>14</sup>

Infection of the pancreas is difficult to handle because of the nature of the tissue, and the constant danger of *secondary hemorrhage*. Deaver<sup>49</sup> in 1912 was doubtful whether hemorrhage ever occurred spontaneously from arterial degeneration. It was

his belief that the pancreatic tissue is so firm and affords such excellent support to its intrinsic vessels, that spontaneous rupture can hardly be expected. In his opinion, the rupture is due to the erosive action of the pancreatic secretion on the vessel walls already weakened by the trauma.<sup>50</sup> Korte, in an article based upon 44 personal observations reported 6 deaths from sudden massive hemorrhage from the wound, occurring at intervals varying from eleven to thirty-four days after operation. In no other part of the body is there such a marked tendency of an inflammatory process to open the blood vessels, and we can only describe it to the digestive action of the glandular secretion upon the vascular walls already weakened by irritation.

A chronic focus of infection in the pancreatic region, with the usual prolonged course of these cases, invites bacteriemia and septicemia to ensue, with the final hyaline degeneration of organs seen in cases of prolonged illness or infection.

Among the *complications* that might set in, in a case or traumatic injury to the pancreas, are the following:

1. Hemorrhage, which might be immediately fatal in severe cases, or become so if occurring after the lapse of several days or weeks.

2. Peritonitis, which usually is generalized, but if the patient survives becomes multilocalized.

3. Secondary anemia, either due to hemorrhage or prolonged sepsis.

4. Abscess or gangrene of the pancreas.

5. Diabetes.

6. Empyema or subphrenic abscess from extension around an abscess of the pancreas.

7. Psychoses and marked debility from prolonged sepsis.

8. Persistent fistulae and eczema from constant irritation of the pancreatic secretions.

9. Disturbances in intestinal motility and digestion.

Up to 1901 there were only 18 cases of pancreatic abscess from all causes reported.<sup>47</sup>



## DIAGNOSIS

The diagnosis of contusion or injury to the pancreas is not always an easy matter. Injury to the pancreas must always be considered in every accident, no matter what the severity of the force might have been, and no matter in what direction the force might have impinged on the body. The diagnosis might be overlooked even when there are characteristic symptoms present, merely because the condition is not thought of. The diagnosis is also apt to be missed in patients who manifest symptoms *a few days or weeks after an accident*.

In a typical case of moderate or severe injury to the pancreas, the most outstanding symptoms are *pain* and *shock*, and the general symptoms of toxic absorption. Moynihan states that "no other catastrophe within the abdomen produces at once such unendurable agony and so profound a collapse." This is due to the *injury to the solar plexus*, which is in the immediate neighborhood of the pancreas, and to the *tension* of the fluid beneath the so-called capsule of the gland. The pain may be in the epigastrium, but usually is in the lumbar part of the back, and the patient is unable to sit up. The pain is absolutely the most severe that the human body can stand, and cannot be relieved by ordinary doses of morphine and atropine. The pain is usually present from the time of the accident, and may persist for hours or days, or until relieved by operation. The pain of hemorrhage into the pancreas is intermittent, being at times very severe and colicky, then diminishing or disappearing, to return later with increased intensity. In other cases of contusion of the pancreas, where the initial injury is of a milder form, the pain may persist for several days, gradually increasing, and finally, with the release of the tension on the capsule, it disappears. This is analagous to the type of empyema of the appendix, which causes severe pain up to the point of the rupture. Sudden relief of the pain is a danger signal, for in several hours, as after a ruptured appendix,

the pain of a peritonitis resulting from the spread of the hemorrhagic fluid of the pancreas sets in. The pain may be in the back, under the left scapula, or between the scapulae. Pain in one of these sites in pancreatic disease is more frequent than pain beneath the right scapula, thus serving to distinguish it from gall-bladder conditions.

The pain in the back has been mistaken for injury to the kidneys and spine, but microscopic examination of the urine and roentgenograms of the spine can rule these conditions out.

Cysts are frequently painless, but in some instances both pain and tenderness are well marked.

Even in abscess of the pancreas, pain is not a constant symptom. It may be absent, as in a case reported by Stibler, but in the majority of cases both pain and tenderness are pronounced.

Hematomata over the epigastrium or over the back should lead one to consider the possibility of pancreatic injury, but even *without* external signs of bruises or contusions, pancreatic injury must be considered.

In contusions of the pancreas, the color of the skin becomes an *ashy gray*, and there is a *cold sweat* upon the forehead. There is a characteristic *cyanosis* around the lips, with an accompanying dyspnea, which if present in any case of abdominal injury should at once suggest the possibility of injury to the pancreas. This was first described by Halstead. There may be patches of slate color distributed irregularly over the surface of the abdomen and limbs. This cyanosis is never found in other forms of acute abdominal conditions. Grey Turner described 2 cases where large patches of discoloration of the skin were attributed to direct action of the pancreatic juice, which in one case reached the umbilicus and in the other, the costo-vertebral angle.

*The pulse is rapid* in injuries to the pancreas, between 120-130, of small volume, and may even become imperceptible.

In early stages of contusion of the pancreas the *local signs* may be insignificant when compared with the severity of the pain and shock. There is usually only slight tenderness and reflex rigidity in the epigastrium or just to the right or left of the umbilicus.

Tenderness over the spine with reflex spasm of the spinal muscles may suggest fracture of the vertebrae, but this can be ruled out by roentgenographic examination.

Vomiting usually does not occur immediately unless there is peritoneal irritation. The vomiting is then persistent, in spite of the passage of stomach tube or lavage. The vomiting occurs at intervals, and is partially responsible for the rapid exhaustion of the patient. The vomiting consists first of gastric contents, then of bile and mucus in small amounts.

Vomiting occurring in a patient some days after an accident should not be passed off as a gastrointestinal upset without examination, for the vomiting might be premonitory of a very serious condition. Nausea and retching, with hiccough, are more frequent here than in cases where there is intestinal obstruction.

The *temperature* with injuries to the pancreas may rise to 101°–103°F. With abscess formation, where operation is delayed, there are rigors and chills.

Should a pseudo-cyst of the pancreas form, the stomach, duodenum and colon may be pressed upon and seriously displaced. The pressure of a "pancreatic cyst" upwards, onto the under surface of the diaphragm, may cause dyspnea from interference with the function of the heart or lungs, and in cases of inflammatory effusion into the lesser peritoneal sac, there may be pressure on the pericardium through the diaphragm, leading to distressing cardiac symptoms.

Honigsmann gives the following table constructed from the records of 48 published cases to show the interval elapsing between the occurrence of injury and the appearance of a tumor in abdomen:

Time Elapsed	Cases
1 week	2
2	3
3	6
4	4
5	6
6	3
6 weeks to 2 mos.	4
After 3 months	5
4	2
6	3
1 year	1
2	2
3	3
5	1
8	1

#### DIFFERENTIAL DIAGNOSIS

One must consider the following conditions in diagnosing a case of injury to the pancreas:

1. *Perforation of the stomach or duodenum.* In these cases there is usually the history of a gastric disorder. The rigidity in perforation is board-like and somewhat generalized. There is no tendency for a patient with a pancreatitis to "double up." Absence of the liver dullness is an important sign of perforation.

2. *Intestinal obstruction* must be thought of because of the persistent vomiting. Visible peristalsis should be looked for, and the occurrence of pain corresponding with the spasm of the intestine noted. Vomiting is projectile in intestinal obstruction, and the ejecta are progressively more and more offensive. Obstipation can occur with pancreatitis and is not, for this reason, a diagnostic sign. Vomiting of fecal matter should at once suggest intestinal obstruction.

3. *Acute appendicitis* is always thought of in acute intra-abdominal conditions, but can usually be ruled out on account of the location, degree and character of the pain.

4. *Pancreatitis*, occurring some time after a trauma, often is mistaken for an attack of *gallstone colic*. However, the pain of colic is relieved by morphine and atropine, and there is usually a history of previous gallstone attacks. Acute hemorrhagic pancreatitis may be accompanied by

jaundice when it results from the impaction of a small stone in the duodenal outlet of the ampulla of Vater. The patient with colic folds his arms across his abdomen, presses against the back of a chair, or edge of a bed, rests a few minutes, and finding no comfort, walks about in agony. A patient with pancreatitis is almost motionless.

Perforation of the stomach or duodenum, intestinal obstruction, gallstone colic, and acute appendicitis must all be thought of in diagnosing an acute abdominal condition in a patient giving a history of injury or accident.

#### DIAGNOSTIC AIDS

In cases of acute pancreatitis, *abdominal puncture* is of value, but must be resorted to with the utmost care. The finding of thin, watery, bloody fluid should suggest the presence of acute hemorrhagic pancreatitis.

Examination of the *urine* for sugar and the application of the various "Cambridge's tests" may be of value, but the results are not consistent.

*Diastase in the urine*, present normally only in small amounts, is increased tenfold or more in cases of pancreatic disease.

*Lowe's test*, which consists of placing 2 to 3 drops of 1:1000 solution of adrenalin on the conjunctiva of one eye, and repeating the dose after waiting a few minutes, might be of value. In cases of pancreatic disease, within fifteen to thirty minutes the pupil of this eye becomes dilated, and remains unchanged, if the disease is not present.

#### OPERATIVE TREATMENT

As soon as the diagnosis has been entertained, operation should be performed. Delay in operating upon injuries to the pancreas means a positive increase in mortality. The pancreas may be approached from in front, or from behind. The former route is preferable.

To approach from in front, the abdomen is opened by a midline incision from the ensiform cartilage to the umbilicus. When

the peritoneal cavity is opened, the pancreas may be reached in one of three ways:

1. Above the stomach, through the gastrohepatic omentum.

2. Below the stomach, through the gastrocolic omentum.

3. Through the transverse mesocolon.

The route below the stomach is usually chosen. A bloodless spot in the omentum is found, below the greater curvature of the stomach, and a tear made therein and enlarged. The lesser sac is thus opened, and the pancreas exposed. If a cyst is present, it will often bulge forward and below the stomach. With recent injuries to the pancreas, an attempt to *control the hemorrhage* should be made, and to *relieve tension, evacuate septic material and fluid, and establish free drainage*. The pancreas is extremely vascular, and it has numerous blood vessels, some of which are quite large. It is not possible in the majority of cases to arrest the hemorrhage by ligation. The tying of a mass of pancreatic tissue often results in the cutting through of tissue and further bleeding. Very often, the only means of arresting hemorrhage is the use of the deep sutures of thick catgut. Extreme care must be taken to avoid the main duct, the superior mesenteric artery, and the portal vein. Extensive disintegration of the gland should be treated by *gauze tampons and drainage*. If the inflammatory collection of the tensely distended gland is incised by multiple blunt punctures, as is generally advisable, gauze packing and drainage will usually prevent general infection of the peritoneum. Occasionally, a *posterior incision in the left costovertebral angle* will sometimes enable the diseased organ to be freely drained.

Incised wounds are sutured with rather thick catgut on a curved needle, some of the sutures passing deeply, others more superficially. The superficial sutures may be of finer catgut.

If the pancreatic duct be wounded, an attempt should be made to expose and suture the edges of the wound with fine catgut; if this cannot be done, one should

suture the edges of the wound with fine wounded duct. This procedure should not be attempted if the patient's condition does not warrant the prolongation of the operation by this attempt to repair.

Punctured wounds of the pancreas are usually repaired by one or two sutures.

All cases of injury to the pancreas should be drained, preferably by a rubber tube, or cigarette-drain, either by the anterior or posterior route, or both. The use of these drains protects to a certain extent the drainage tracts from the digestive properties of the pancreatic fluids.

The operative treatment of subacute pancreatitis resulting from injuries consists of incision, and drainage of pancreatic sloughs and collections of fluid or pus.

It is advisable, in some cases, to perform a cholecystostomy, to circuit the bile away from, the injured area, and thereby lessen the chances of adding additional factors to the pathology of that region.

#### AFTER-TREATMENT

This consists primarily of *supportive treatment* to overcome the affects of the shock of the pathological condition, and operation. Stimulation with caffeine, strychnine, digitan, subcutaneous injections of saline, and stimulating enemata containing whiskey should be used. *Constant attention* to the patient for the first seventy-two hours is most imperative, because of the many complications which are possible. Secondary hemorrhage, blockage of drainage tubes, postoperative shock and diabetic coma are some of the conditions that may be expected. An estimation of the blood sugar at intervals is essential after injuries to the pancreas, and insulin should be used when indicated. The blood of the patient should be grouped and a donor kept on hand to be used in case transfusion is necessary. It is only by attending to every symptom religiously that one can hope to save a patient's life after injury to the pancreas.

Should the patient recover from the post-operative shock and survive the

first week, one must be prepared to recognize any localizations of the inflammatory process within the peritoneal cavity. These take the form of intra-abdominal abscesses, which may point either in the lower part of the abdomen, or in the costovertebral angles. Subphrenic abscess with extensions into the pleural cavity have been recorded after injuries to the pancreas. These abscesses should be opened and drained after localizing, using local anesthesia whenever possible.

Pancreatic asthenia, a condition described by Whipple,<sup>54</sup> sometimes occurs after operation upon the pancreas or biliary tract. The patient is listless, apathetic, unresponsive to those around him; lacks appetite; complains of nausea and may vomit; rapidly becomes emaciated, complains of extreme exhaustion and has no desire to recover. The blood pressure is low. These symptoms appear within two or three days after operation, but are sometimes delayed for many days. They begin insidiously; they often disappear quickly, and the appetite may return all at once. Moynihan has had 3 cases of this kind, and has treated them with 5 per cent glucose solution intravenously followed by insulin.

Speese and Klein<sup>55</sup> record an interesting case in which insulin was used to safeguard against the defects of carbohydrate metabolism.

Antidiabetic diet should be used, consisting almost entirely of fats and albumen, as advised by Wohlgemuth in 1910. Sodium bicarbonate should be administered to lessen gastric acidity, which excites pancreatic secretion. This should be given with the meals. Pankreon may be given to substitute the pancreatic secretion lost through the fistula. Erepton proved effective in closing a pancreatic fistula in a case of rupture of the pancreas reported by Kroiss in 1911; about 100 gm. were given daily, 20 gm. at a dose, by mouth in sweetened coffee or warm milk; or by rectum in doses of 50 gm. In this case the fistula closed in about

ten days. The skin around the *fistula* which usually develops after operations upon the pancreas, should be protected from the digestive action of the pancreatic secretion, by alternate use of zinc oxide ointment and vaseline.

### PROGNOSIS

The prognosis depends upon many factors, the most important being:

1. The severity of the trauma.
2. The direction of the force.
3. The location of the impinged area.
4. The resistance and build of the patient.
5. The severity and rate of the hemorrhage.
6. The time elapsing between the injury and the onset of the symptoms.
7. The time elapsing between the onset of symptoms and the diagnosis and treatment instituted.

The prognosis should be extremely guarded on account of the seriousness of the injury and the many complications which might set in immediately after the operation, or some time after. It is the consensus of opinion that the vast majority of patients with contusions and injuries to the pancreas die.

Disregarding any classification as to *etiology* of inflammations of the pancreas, some idea as to the mortality when treated medically, and by operation may be obtained from the following table:

Author	Year	No. of Cases	No Operation	Operation	No. of Recoveries
Dreesman....	1908	36	36	0	4
Ebner.....	1907	20	20	0	2
Lenormant		36		36	17
and Lecene.	1906	36		36	6
Lerich and Arnana....	1909	39		39	13
Korte.....	1911	118		118	73
Linder.....	1917	16		16	
		15		15	
Bloodgood....	1919	11		11	8
Deaver and Ashhurst...	1921	193	32		8
				161	67

Schmieden and Sebening, in a study of 150 cases of pancreatitis *due to all causes*, give the following table concerning the operatively determined degree of pancreatic pathology and the cures for the various stages; the figures in the first column giving the percentage of cases of the respective stage which came to operation:

	Cured, Per Cent	Died, Per Cent
9.2 Edema without fat necrosis....	76.3	23.7
35.4 Edema with fat necrosis.....	62.5	60.1
25.1 Hemorrhagic infarcts.....	36.1	56.9
19.3 Necrosis and areas of softening.	32.0	68.0
3.4 Sequestration.....	43.1	63.9
7.6 Abscess formation.....	39.9	37.5
Averages.....	48.8	51.2

All who have had experience in treating cases of acute pancreatitis urge immediate operation. Whenever a case is seen before diffuse peritonitis sets in, the surgeon should lose no time in operating to evacuate the toxic fluid. Immediate operation should be done even if the patient is in shock, for *the pathological processes of pancreatitis are progressive*. Where injury to the pancreas is done by penetrating objects, the sooner the hemorrhage is stopped and drainage established the better the chance of recovery. In cases of subcutaneous injuries, operation should be performed as soon as the diagnosis is established.

### CASE REPORT

The following is the case report of a patient who was thrown to the ground by an automobile, being hit in the left side and back. The patient suffered severe pain in the back and abdomen for six days, and was about to leave the hospital on the eighth day when she went into severe shock and collapse, and had agonizing pain in the abdomen. Laparotomy revealed a hemorrhagic pancreatitis, with diffuse peritonitis and fat necrosis. The patient recovered after a ten months' stay in the hospital during which time two large intra-abdominal abscesses were opened. Later, a subphrenic abscess developed, which was drained. This case,

being one of the very few which have ever recovered, is described in detail.

Mrs. R. R., aged forty-five years, was hit by an automobile on August 12, 1926. Her past history was negative, the patient having always enjoyed an active and healthy life. About two years prior to the accident, she had a hysterectomy for fibroids, at which time exploration revealed no pathology in the gall bladder or other organs outside of the pelvis. Her appendix was also removed at this time.

The patient's husband and four children are all living and well.

When first seen by me, the patient was in front of her home, having just been transported by the automobile which hit her. She was unable to stand, and had to be carried from the street up three flights on a chair to her apartment. The patient was in moderate degree of shock, complaining of pain in her left hip and lower part of her spine, frontal headache and dizziness. Her pulse was 104, regular and of fair quality. Her skin was cold and clammy, and the face was ashen. Careful examination revealed marked tenderness over the left side of her chest in the posterior axillary line over the seventh and eighth ribs, and marked tenderness in the left hip region and over the lower part of her back. Besides, she had multiple contusions and abrasions of all her extremities. There was also marked tenderness over the lumbar vertebrae with reflex spasm of the spinal muscles, and a diagnosis of possible fracture of the spine was made. The patient was put in shock position with her head lowered, blankets and heat were applied, and whisky and black coffee administered. The patient was moved to the Hospital for Joint Diseases as soon as an ambulance was obtained.

The first day at the hospital, the patient complained of extreme pain in her back and neck, and was unable to raise herself to a sitting position. She also complained of dizziness, and examination by the house doctor was impossible. The following day she felt somewhat better, but the pain in her back and neck persisted. Her pulse was of good volume, but the rate was slightly increased to 84-86. Roentgenograms were taken of her arms, legs and thighs, and lumbar spine, and all were reported negative for fracture. The second day after the accident she felt better, and had entirely reacted from the shock; her pulse

was between 76-82. The third day after the accident, the pain in her back had gone, but it was still tender to touch, and she still complained of pains in her extremities. Two days later she again complained of pain in her back; her pulse was between 74-78.

On the morning of the eighth day following the accident the patient was suddenly taken with severe upper abdominal pain, nausea, and vomiting. Her general condition looked very poor, and she vomited continually all morning. The pain was most excruciating in the epigastrium, radiating to the back, and suggested an attack of severe gallstone colic. Atropine and morphine failed to relieve the pain. Her pulse was very rapid and weak. A consultant who was called made a diagnosis of gallstone colic.

The patient was transferred to the Mt. Sinai Hospital that same day, and was seen by Dr. A. A. Berg that evening. Her blood count was w.b.c. 10,300; polymorphonuclears 88 per cent, lymphocytes 6 per cent, monocytes 6 per cent. A tentative diagnosis of gallstone colic was made, and on account of the excitement and the poor condition of the patient, operation was not performed until the following morning. The blood count that morning was w.b.c. 15,200; polymorphonuclears 85 per cent, lymphocytes 14 per cent, monocytes 1 per cent. Just before the operation, the signs changed somewhat; the pain had been unrelieved by morphine, and the diagnosis was indefinite. Intestinal obstruction and ruptured viscus were also thought of.

At operation a moderate amount of hemorrhagic fluid escaped through the incision, pressing omentum into the wound; this was covered with miliary foci of fat necrosis. Palpation revealed a rather dense gall bladder in which no stones could be palpated. The region of the gastro-pancreatic-colonic area was suffused with blood, and the head of the pancreas was felt to be the size of an adult fist. Puncture of the swelling revealed it to be an hematoma. The body of the pancreas to the left of the median line felt normal. There was an accumulation of hemorrhagic fluid along the gutter of the posterior abdominal wall, from the colon to the pelvis. Numerous foci of fat necrosis were seen all over the fat in the gastrohepatic region and the large omentum.

A drainage tube was passed through the gastrocolonic ligament down to the region of the hematoma in the head of the pancreas,

and another tube put into Morrison's pouch. Cholecystostomy was done, and gauze drains placed down to the subhepatic region around the gall bladder. The abdominal wall was closed in layers. A culture of the gall-bladder bile sent to the laboratory was sterile.

Following the operation the patient was in severe shock. The temperature went to  $104.2^{\circ}$ , and at times the pulse was so rapid and weak that it could not be counted. At 5 P.M. that day, her hands became cold, clammy and cyanotic, and her pulse imperceptible, and her family was called in because it looked as if she were going to die. However, she reacted to the intensive and persistent stimulation of caffeine, camphor and digifoline by hypodermic injection; whisky, bicarbonate of soda and coffee by rectum; and repeated subcutaneous infusions of normal saline solution under the breasts.

The patient's temperature remained elevated around  $102^{\circ}$  for *a week*; her pulse was very rapid, between 120 and 160 almost constantly. For four weeks following that, her temperature ran between  $100^{\circ}$  and  $103^{\circ}$ , and then a low-grade temperature between  $101^{\circ}$  and  $102^{\circ}$  for *three months*. During this time, her wound constantly discharged bile and pancreatic juice, and she showed considerable loss of weight. Her skin was loose, her face drawn, and her limbs were very thin. She also lost a lot of her hair. On October 30, a fairly large piece of stinking necrotic pancreas came out through the wound. This wound continued draining for over *eight months*.

Her hemoglobin on October 22 was 47 per cent which shows what a severe secondary anemia had developed. This gradually improved, as follows: October 29, 53 per cent; November 5, 54 per cent; November 19, 56 per cent; December 4, 56 per cent.

On November 12, her blood count was: w.b.c. 12,300; polymorphonuclears 72 per cent, lymphocytes 25 per cent, monocytes 3 per cent. On December 16: w.b.c. 8400; polymorphonuclears 77 per cent, lymphocytes 21 per cent, monocytes 2 per cent. On December 20, w.b.c. 11,000: polymorphonuclears 78 per cent, lymphocytes 21 per cent, monocytes 1 per cent. On December 31: w.b.c. 5500; polymorphonuclears 71 per cent, lymphocytes 29 per cent.

During the course of the low-grade septic temperature, two intra-abdominal abscesses were localizing, which with careful flaxseed

poulticing came near the surface, the first of which was opened under local anesthesia on January 2, 1927, *four and one-half months* after her first operation. A 2.5 inch left lateral incision with center opposite the umbilicus was made by Dr. Berg. On opening the peritoneum, thick pale greenish pus in a large quantity poured forth. A rubber tube and two gauze drains were inserted into the encapsulated intra-abdominal abscess. A culture of the pus showed *Staphylococcus aureus*. The second abscess localized in the right lower quadrant of the abdomen. This was opened on February 7, 1927, *five and one-half months* after the first operation, by a 2 inch incision under general anesthesia, slightly to the right and below the umbilicus. On opening the peritoneal cavity, a considerable quantity of thick pale greenish pus was evacuated; this pus was also cultured, and found to be *Staphylococcus aureus*. The cavity was well walled off, one rubber tube and one gauze drain were inserted, and the wound left open.

The reaction following the operation on January 2 was quite severe; her temperature rose to  $104.2^{\circ}$ , and she required stimulation with subcutaneous infusions, digitan, and stimulating enemata of coffee and whisky, but then remained low the next four weeks. Following the opening of the second abscess, the temperature remained low, and her condition gradually improved. These abscesses were unquestionably from the localization of the diffuse peritonitis found at the very first operation in August, 1926. The patient left the hospital on June 6, 1927, having gradually recovered some weight and strength, after *ten months* in the hospital.

In August, 1927, the patient developed signs of subacute intestinal obstruction and pneumonia, and was confined to bed for a week.

In the early part of October, 1927, the patient developed pain in the left upper quadrant and back. Physical examination showed marked dullness at the left base posteriorly, and roentgenographic examination revealed an elevation of the diaphragm on the left side. The patient re-entered Mt. Sinai Hospital. On October 10, blood count showed w.b.c. 13,600; polymorphonuclears 82 per cent, lymphocytes 12 per cent, transitional 4 per cent; eosinophiles 2 per cent. Aspiration at the tenth interspace at the left base revealed thick pus which showed on culture *B. coli*; this pus was also tested for pancreatic ferments,

and amylase was found. On October 11, a *subphrenic abscess* was opened and drained under local anesthesia. An incision was made over the left costal angle between the anterior and posterior axillary lines, and a section of the tenth rib about 2 inches long was removed. The peritoneum was opened. Exploration revealed no large collection of pus as far as could be explored with the finger. The proximity to the splenic vessels prevented any deep exploration and in view of the previous discovery of pus with the aspirating needle, the subphrenic space was drained; three packings were placed under the diaphragm, and two under the liver. After several days, these packings were removed, and the wound discharged pus. The pus continued to drain from this last wound, the opening of which gradually became smaller. On December 3, 1927, her temperature suddenly shot to 104.2°, the patient had a slight chill, and there was a discharge of bile from this wound. The character of this discharge soon became watery, and the patient was finally left with a sinus discharging *pure pancreatic secretion*. On December 30, 1927, the patient left the hospital with a discharging sinus, her general condition having improved considerably. The sinus discharged continually for two months, when the tube was removed, and the sinus allowed to heal. After several days, the patient suffered severe pain in the left upper quadrant, and the sinus had to be reopened to allow a considerable amount of secretion under tension to escape. The sinus continued pouring forth pancreatic secretion, until the middle of March, when the tube was removed, and the sinus again allowed to close. It remained closed for three weeks, and then the patient suddenly developed severe pain in the left upper quadrant. Upon reopening the sinus, the retained secretion was under such tension that it shot out several inches on escaping. The sinus continued to drain until June 23, when it closed, and no symptoms of retention have developed since then.

An interesting point about this case, is that although the pancreas suffered considerable destruction causing a large part of it to slough away, only once was there any sign of pancreatic insufficiency of internal secretion. That was immediately after the first operation in August, 1926. A close control of her sugar metab-

olism was kept by daily examination of her urine, and determination of her blood sugar. On August 21, her blood sugar was 0.128; August 24 0.140; August 27 0.160. Her urine showed 0.55 per cent sugar for the first time on August 26, five days after the operation. On August 27, it showed a faint trace, and on August 29, a slight trace of sugar.

A blood Wassermann test taken May 24, 1927 was negative.

The prognosis from this point is difficult to state. Just how long the sinus will remain closed cannot be stated, nor can one state when the process around the pancreas will heal. One can expect a gradual fibrosis of the remaining portion of pancreas with a final development of a diabetic condition which may prove fatal.

The patient, of course, is always in danger of an intestinal obstruction, from the adhesions within her abdomen. It is also possible that she may get an incarcerated or strangulated hernia in the sac of a ventral hernia which resulted from the first operation.

Her general condition at present is very good, her appetite good, and color excellent. She has three abdominal scars from operations, and one scar in the left lower axilla. She has a postoperative ventral hernia from the first operation, and a possible cyst of the pancreas.

NOTE: As this article goes to press, the patient recently has developed a diabetic condition, with blood sugar of 308 mg. per 100 c.c., and with 4 per cent sugar in her urine. Under careful dieting, her blood sugar and urine have returned to normal.

A slight tenderness and the development of a mass over the region of the tail of the pancreas points, in all probability, to the presence of a pseudo-cyst of the pancreas. This condition, as well as the diabetes, had been anticipated. Notwithstanding her present condition, she is very active and able to do her housework.

I wish to take this opportunity to thank Prof. Luigi Frassi of Milan, Italy, for his personal communications, and Dr. A. A. Berg for his invaluable assistance in this case



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# CYTOLOGICAL STUDY OF GONORRHEAL PUS\*

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THE defense mechanism of the human organism against gonococcic infection is still obscure. The facts that animal experiments are not available and that human pathological specimens of uncomplicated gonorrheal infections in all stages are difficult to secure are the two main obstacles to a thorough investigation.

Due to the conspicuousness of the purulent urethral discharge, which consists almost wholly of polymorphonuclear cells, most observers have been led to a viewpoint which considers the polymorphonuclear cell to be the primary defensive tool of the body against the gonococcus. The usually very marked phagocytosis is strongly suggestive, especially in view of the well-known experimental work in staphylococcus and streptococcus infections. The very word phagocyte is already leading or possibly misleading toward a conclusion. However, in spite of the microscopic picture, phagocytosis does not seem to accomplish much beyond the purely mechanical achievement of carrying a certain number of organisms into the urethral lumen where they can be washed away. It even seems that the gonococcus thrives a little better in the presence of pus, and it is quite evident that the polymorphonuclear cell is usually worsted in its symbiosis with the gonococcus. It has been conclusively shown that gonococci which have been devoured grow as well in cultures as free ones, and it also has been shown that the amount of phagocytosis has no bearing on the time of recovery in otherwise uncomplicated cases. It furthermore has been demonstrated that the gonococcus *per se* exerts little positive chemotaxis towards the polymorphonuclear cells, but that the gonococcus endotoxin, which is liberated after the death of the gonococcus, is a

powerful positive chemotactic substance. It seems, therefore, that the polymorphonuclear cell does not occupy such a conspicuous position in the defensive scheme as the clinical evidence suggests.

The other factor which plays a great rôle in theory is immunity in a serological sense. The facts of serological immunity in general are too enticing to be ignored, even if there is no evidence that the body has the power of forming effective antibodies against the gonococcus. This lack of power is really most striking clinically and consequently therapeutic efforts in this direction have been bound to fail and have failed. Antibodies, as demonstrated by the complement fixation test, are merely specific protein reactions; they do not necessarily imply the presence of therapeutically effective antibodies.

But of course the human body is victorious against the gonococcus and therefore must have a defense mechanism of some kind. There are several clinical facts which are clearly indicative of the kind of defense employed. The first is, of course, the fact that the defensive processes are purely local; apparently they occur only where the gonococcus actually lives. The adnexa, the various metastatic foci, and the areas of contact infection (for example the conjunctiva) react to the gonococcus as if they were primary foci and undergo the same rather tedious defensive period as the primary focus.

The second fact lies in the observation that the local defensive mechanism rather quickly disappears with the disappearance of the gonococcus. An anterior urethra will show acute symptoms again if reinfected by gonococci from the prostate; artificial infections of the anterior urethra in chronic gonorrhea invariably produce again an acute urethritis. However, this

\* From the Urological Service of Brooklyn Hospital and the Venereal Clinic of the Department of Health, New York City. Read before the Section on Genito-Urinary Surgery, New York Academy of Medicine, April 17, 1929.

second urethritis is usually shortlived, indicating some kind of readiness or preparation. This clinical fact is so evident

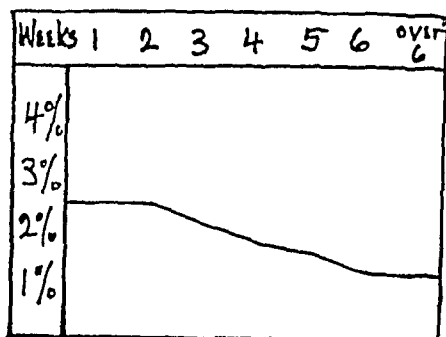


FIG. 1.

histiocytes, and other large mononuclear cells are everywhere in evidence. Their presence is usually overshadowed by the

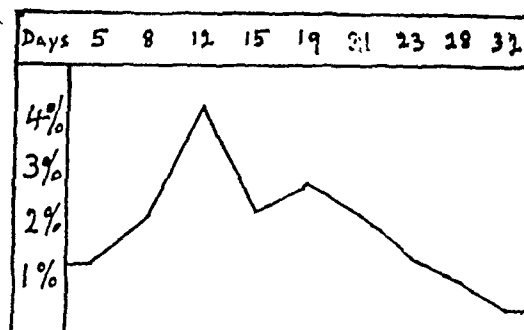


FIG. 2.

that most clinicians take a second gonococcus infection much more lightly, provided it occurred within a reasonably short time. On the other hand the first gonococcus infection is usually considered to be a vicious one.

The third suggestive fact is furnished by our therapeutic experiences. It does not seem as if the bactericidal powers of the drug used for urethral injections are so very important; some of the most powerful delay the cure beyond the average time limit without local therapy, and some of the very weakly bactericidal drugs have an undoubtedly beneficial effect, shortening the course of the disease by many days. In other words, it is not the effect of the drug on the gonococcus but its effect on the urethral mucosa which is of primary importance. These considerations, which can be augmented, lead to the assumption of a local apparatus, which is slowly elaborated, which rather quickly disappears, and which is to a certain extent responsive to local pharmacological stimuli. It is evident that the apparatus must be cellular, and since the polymorphonuclear defense has been found to be inefficient, it is indicated that the reticulo-endothelial defense mechanism in gonorrhea be investigated.

The pathological findings in all types of gonococcal infections suggest very strongly that the reticulo-endothelial system plays an important rôle. Plasma cells,

dense polymorphonuclear cell infiltrations, but the latter is by no means as intense in the tissue as in the lumina of hollow organs and on the mucous surfaces. It is furthermore evident that the polymorphonuclear reaction is mainly due to the amount of gonococcal endotoxin liberated and since the gonococcus grows much more profusely in the urethral lumen than in the submucosa this probably explains the relative distribution of the various cellular elements. In mild and recent gonococcal joint infections the joint fluid contains mononuclear cells rather than polymorphonuclear cells. In histological examinations of recent urethral infections it has been shown that round cell infiltrations occur with great speed, even before the appearance of the purulent urethral discharge. In accumulations of gonorrheal pus it is common to see the zone of limitation to consist almost entirely of plasma cells and histiocytes.

Cytological examinations of gonorrheal pus have been made, but most of them are concerned with the behavior of the polymorphonuclear cells toward the gonococcus or with the numerical index of cells with basophile and eosinophile granulations.<sup>1-6</sup> Pappenheim<sup>7</sup> and Neuberger<sup>8</sup> have both investigated the mononuclear cells of gonorrheal pus. Pappenheim thought that the large mononuclears have a regenerative function and that they appear in particularly large numbers as the disease becomes

chronic. He stated that his average findings showed 10 to 15 per cent of large mononuclears, and 1 to 2 per cent of lymphocytes.

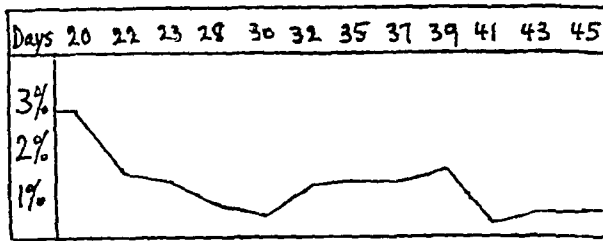


FIG. 3.

Neuberger's comment was that the mononuclear cells have no relation to the stage of the disease or to the prognosis. Aside from this, Wile<sup>9</sup> has found that the mononuclears in the blood stream are increased in number when a chronic gonococcal infection is present.

In an inquiry of this kind the shortest approach to the problem would be through detailed histological examinations of tissues from uncomplicated infections in all stages. A second route would be through the investigations of tissue reactions towards the various drugs which have been used locally in gonorrhea; and if there should be some reaction mode which distinguishes the effective drugs the knowledge of this reaction should prove to be highly valuable for an understanding of the body's defense mechanism. These approaches are difficult either because of lack of material, or of lack of armament; gonorrheal pus, however, could be easily obtained and while its investigation was not very promising, it could be carried through without much difficulty. It was not to be expected that much could be found in advance of Pappenheim's and Neuberger's findings, but a confirmation of these findings and a stimulation towards research along the lines indicated would have been sufficient. However, these cytological studies brought out a valuable lead which should be the adequate stimulus to more intense and more appropriate investigations.

The technic used in these cell counts was as follows: A small amount of pus

was taken from the anterior urethra with a wire loop and spread thinly on a glass slide. After drying, the smear was fixed

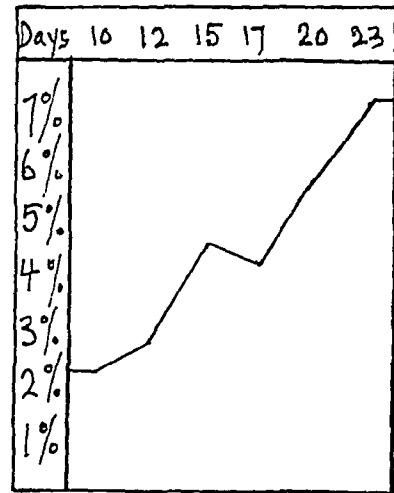


FIG. 4.

by heat and Pappenheim's stain\* applied for two to three minutes. After washing and differentiating with alcohol the smear was examined for its percentage of large mononuclear cells and for the presence of gonococci. Usually 500 cells were counted for the determination of the percentage. Stained thusly the polymorphonuclear cells appear green with dark green nuclei. The lymphocytes show a light green nucleus with a bright red cytoplasm and the large mononuclear cells have a very pale nucleus with markedly pink cytoplasm. The epithelial cells have a well-stained green nucleus and usually a light green cytoplasm with the exception of squamous cells, the body of which sometimes shows slightly pink. The gonococci are bright red.

The most prevalent mononuclear cell found in these smears is distinctly larger than a polymorphonuclear cell; its nucleus is round or oval, but sometimes is indented as in the so-called transitional cells of the

\* Pappenheim's stain:

Solution 1: Saturated solution of pyronin.

Solution 2: Saturated solution of methylgreen.

Just before staining solutions 1 and 2 are mixed in proportions of 1 to 2 or 1 to 3 or thereabouts according to previous trial. The methylgreens on the market vary considerably. Some stains do not require differentiation with alcohol, but most of them do.

blood stream. The cytoplasm is pink and apparently very fragile; vacuolation and fringing of the margins are common.

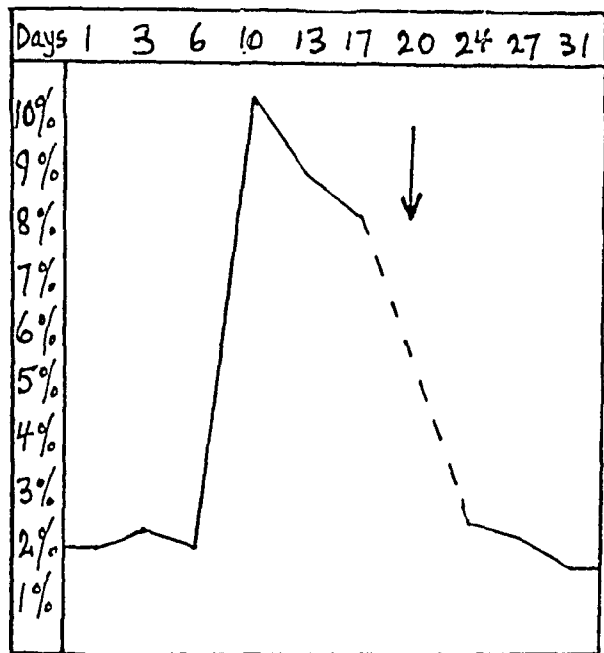


FIG. 5. Arrow indicates cessation of treatment.

The cytoplasm usually surrounds the nucleus as a large round mass, but pseudopods and odd deformities are frequently seen. These cells are probably identical with the macrophage of Maximow and are of histiogenic origin. Their phagocytic ability is evident from the detritus of cells frequently found within them; however, gonococci were only rarely seen within. With the usual bloodstains these cells are not very easily identified; some of the cuboidal epithelial cells appear then frequently very much like these wandering cells. Particularly when they appear in plaques or sheets, which is not uncommon, the differentiation by the Pappenheim stain was found to be indispensable. With the latter stain confusion of the large mononuclear cells with epithelial cells is almost out of the question. Other much smaller mononuclear cells are lymphocytes or plasma cells. They are scarce; their cell mass is much more scant and their cytoplasm stains bright red.

An attempt was always made to collect

a series of smears from each patient, but many times this was impossible either due to a quick cessation of the discharge

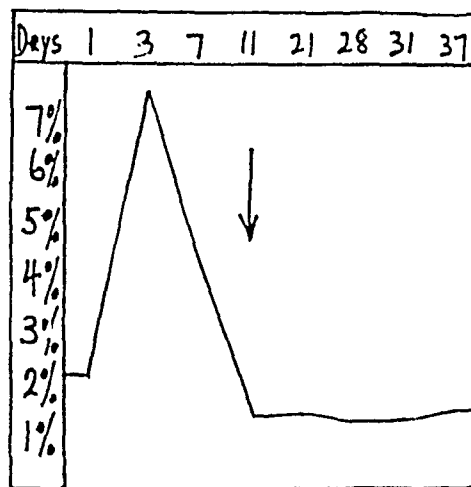


FIG. 6.

or due to the patient's irregularity of attendance. Altogether 121 patients were examined and 352 smears taken. The average of large mononuclear cells in these smears was 2.3 per cent, the highest being 12.4 per cent and the lowest 0.2

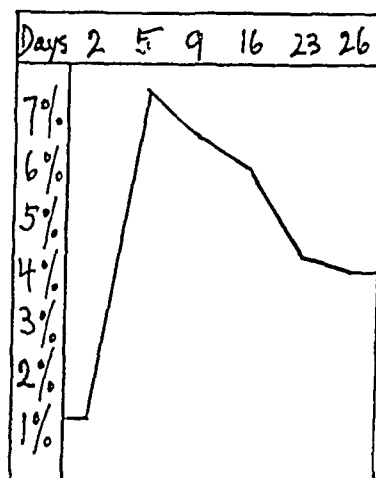


FIG. 7.

per cent. The average of the untreated cases (89) as they came to us was 2.1 per cent; the untreated cases classified as to the duration of their infection showed a slightly declining curve as illustrated in Fig. 1. It seems evident, therefore, that the duration of the disease has little influence on the mononuclear count.

The presence of complications also does not seem to have any bearing, since 37 uncomplicated and untreated cases showed

the lowest 0.2. The curve (Fig. 3) illustrates the rather even and persistent percentages.

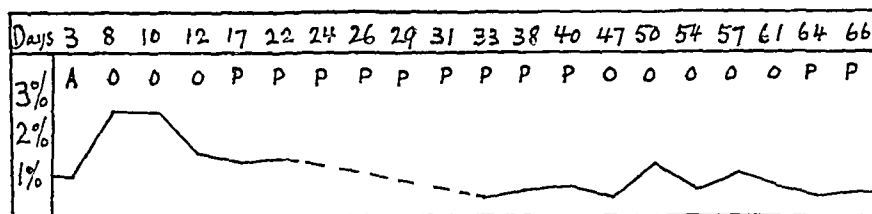


FIG. 8. A, acriflavine; O, ol. santali; P, protargol.

an average of 2.5 per cent mononuclears, while 37 cases with complications showed an average of 2.4 per cent. Smears from 6 cases of acute epididymitis gave an average of 2.2 per cent. There is also no difference between first gonorrheal infections and repeated infections. The average of the first is 2.3 per cent, that of the second 2.1 per cent. All the figures given so far were collected from patients who at the time of the examination did not receive any local treatment.

We have no series of cases which were left entirely untreated during the stage of active discharge, but we have a large group of patients who received merely oleum santali by mouth in small doses for many days at a time. Smears collected during this period show remarkably little fluctuation in the mononuclear percentage. The average from these smears is 1.5 per cent; the highest figure is 4.2 and the lowest 0.2. In 68 smears of this kind only one exceeded the percentage of 4. Plotted as curves, slight rises and depressions can be seen; they are not steep and their explanation lies well within the possible limits of error. An illustrative chart (Fig. 2) shows the most marked fluctuation found.

There is also a group of patients treated with injections of  $\frac{1}{2}$  per cent silver protein solutions of the protargol type. This group shows findings identical with the group receiving oleum santali. Forty-two smears of this group showed an average of 1.5 per cent mononuclear cells. The highest percentage was 4 and

The next group, however, shows great differences; it concerns 64 smears taken from patients who had been using urethral injections of acriflavine solution (1:4000). Here we have an average percentage of 4.3; 12.4 being the highest and 0.2 the

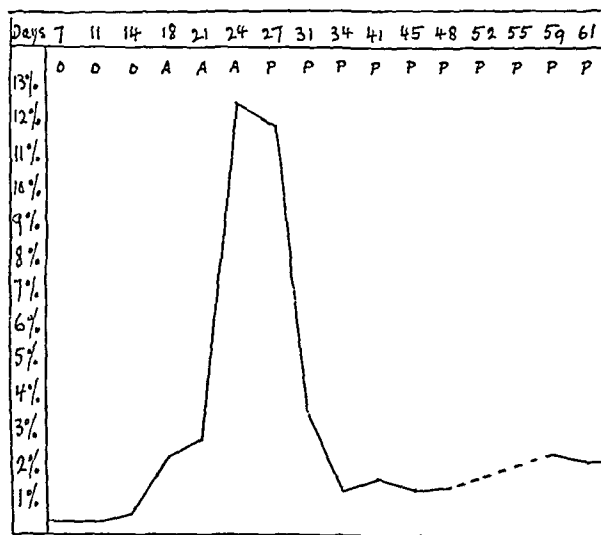


FIG. 9.

lowest. Not less than 26 smears in this group showed a percentage figure of over 4. Expressed in curves, the influence of the acriflavine appears most marked (Figs. 4 and 5).

Then there is a last group of patients who used injections of necaron in solutions of 1:2000. Necaron is a mixture of sodium silvercyanate and sodium cholate. The average of 24 smears was 3.7 per cent, the highest 10.6 per cent, and the lowest 0.2 per cent. Nine smears of the 24 showed a percentage higher than 4. The curves too (Figs. 6 and 7) show a marked influence of the local treatment on the percentage

of mononuclear cells. Two additional charts (Figs. 8 and 9) illustrating the curves of percentages during mixed treatment are shown for corroboration.

These findings seem to be rather definite and unequivocal. Without local treatment, and during local treatment with protargol, the percentage of mononuclear cells in gonorrheal pus remain low throughout. After local treatment with acriflavine and with necaron a sharp rise in the mononuclear percentage occurs in the majority of cases, the rise being more marked after acriflavine than after necaron. The respective majorities are 22 out of 25 with acriflavine and 9 out of 12 with necaron.

The interpretation of this is difficult, but a suggestion may be made which might prove to be of importance. Acriflavine has been examined as to its local effect on tissue and it has been found that it has a very marked local influence on reticular endothelial proliferation where it is deposited even in highly diluted solutions.<sup>10</sup> This observation has been used to explain its sometimes marked effect on septic infections, since the therapeutic doses are usually so small that the bactericidal effect is negligible. Is it not likely that its activating effect on the reticulo-endothelial elements may also be responsible for these cytological findings? If this is the case and if we admit the rather

striking superiority of acriflavine in acute anterior gonorrhea over most other drugs, then it would be logical to assume that the reticulo-endothelial system is an important factor in the defense of the organism against the gonococcus. Further investigations are being undertaken to clear this point.

If further findings should be affirmative they may lead to an experimental method of evaluating at least partially the drugs which are in use at the present time for the treatment of gonorrhea and others which will be advanced for this purpose. Such findings may also allow an evaluation of the patients specific and individual response towards various drugs which may in turn allow a more individualized and more effective treatment.

#### CONCLUSIONS

1. Large mononuclear cells are commonly present in gonorrheal pus; their percentages vary between 0.2 and 12.4.
2. The mononuclear percentage is not influenced by the duration of the infection or by the presence of complications.
3. After local treatment of the anterior urethra with acriflavine or necaron solutions sharp rises of the mononuclear percentages occur.
4. Without local treatment and after protargol injections these rises do not occur.

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# GASTRECTOMY VERSUS GASTROENTEROSTOMY IN GASTRODUODENAL ULCERS\*

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ALTHOUGH our knowledge of gastroduodenal ulcers is still far from complete, decided progress has been made. We are still in the dark not only upon many of the refinements, but likewise upon such questions as the causation of gastric and duodenal ulcers, their clinical course, the question as to when they are medical and when they are surgical, and if surgical whether best dealt with along conservative or along radical lines.

There is much to justify the belief that gastroduodenal ulcers are to some extent a by-product of our present-day civilization. A very careful inquiry while traveling in such backward countries as Africa, India, Indo-China, and China has convinced me that such diseases as gastroduodenal ulcers are rareties in comparison with their frequency in the advanced western countries where life is far more strenuous.

The classical experiment of Pawlow is not out of harmony with this thought. We all know of appetites that have been arrested through the influence of unwelcome news, and the effect of wines and a pleasant conversation during a dinner all point to the same end, namely, the influence of the nervous system upon the digestive process. Repetitions of this disturbed process may be but the first step of a functional derangement, which, if continued, may through an altered chemical action result in organic changes such as ulceration and which in a certain percentage of cases may terminate in malignancy. This is hardly an unreasonable hypothesis upon the evolution of the gastroduodenal pathology and one that has possibly been insufficiently emphasized. Once established, the chronicity and prog-

ress of the condition seem largely dependent upon two factors: hypermotility and hyperacidity. The importance of hyperacidity is emphasized by the influence which the location bears upon the existence of ulcer. In the *Magenstrass* of Waldeyer and the pyloric region the factor of hypermotility is presented. On the side of hyperacidity, the almost generally accepted influence upon the origin and clinical progress of the ulcer, especially the duodenal ulcer, there is a fairly well-established belief that the direct influence of hyperacid chyme is, if not the only, at least a very important factor in the production of duodenal ulcers and a still more effective one in the production of the gastro jejunal and jejunal ulcers not uncommonly following gastroenterostomy.

Furthermore, the clinical results almost indisputably prove that those surgical procedures that most specifically deal with hypermotility and hyperacidity are attended with the highest percentage of success.

That there is a medical side to this condition, though somewhat ill defined, cannot be denied, but to wait until perforation, hemorrhage and other complications arise before resorting to surgery is not unlike our past attitude in appendicitis, of waiting for another attack. This is especially true if we remember that ulcer cases get well with any form of medical treatment or even no form of medical or surgical treatment, but unfortunately are not likely to remain well. There is a distinct periodicity in these cases, "an ebb and a flow," which is but a part of our incomplete understanding of the condition.

Out of the haze that still surrounds this, the radical features are gradually becoming more clearly defined and more firmly

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established. This change from the conservative to the radical had its origin in Europe, and is gradually extending throughout the United States. The European surgeons became dissatisfied with their end results with gastroenterostomy, looked further, decided upon gastrectomy and now seem satisfied with their decision. The change to the radical treatment in America has been slower and this slowness many have attributed largely to the powerful moulding influence of the Mayo Clinic, where over 8600 gastroenterostomies have been performed with a claim of 90 per cent cure in gastric and 95 per cent in duodenal ulcers, with but 2 per cent complications of jejunal ulcers. Such a powerful argument from such an authoritative source cannot fail to wield a telling influence. There is no good reason why any one who is able to secure such results with gastroenterostomy should change to the more difficult gastrectomy, since the latter in the best hands can hardly expect to excel this result. But other surgeons have been unable to obtain such results, so they have followed in the footsteps of their European confreres and are satisfied.

Since it is not reasonable to expect a normal human being to prefer the more difficult partial gastrectomy to the much easier gastroenterostomy provided the latter yielded about the same results, it becomes necessary to look elsewhere for the explanation. Since it is easier to do a gastroenterostomy than a partial gastrectomy and since the mortality following partial gastrectomy is much higher, not in the hands of the specially trained few but in the hands of the many not specially trained, the reason that the many at least are preferring gastroenterostomy to gastrectomy seems perfectly obvious. In such surgery, however, the operative procedure is based upon what the operator can supply rather than what the pathology demands.

That gastrectomy in the hands of surgeons not specially trained, though

experienced, has a higher mortality than gastroenterostomy is a well-established fact but in the hands of specially trained surgeons, it has also been established that partial gastrectomy need have no higher mortality than gastroenterostomy and that the end results of partial gastrectomy, such as safeguarding against malignancy, perforation, reactivation, new ulcers, hemorrhage and gastrojejunal ulcers, are so much better than those of gastroenterostomy, that gastrectomy is naturally the accepted operation by those who are able to perform partial gastrectomy without a prohibitive mortality.

The surgery of today is exacting as to results and there are some surgical procedures that demand special training, even from an experienced surgeon, in order to obtain the results to which modern surgery is justly entitled, and partial gastrectomy is an illustration of that fact. The mortality following gastroenterostomy has hardly been fairly balanced against that following gastrectomy. In gastrectomy the danger of malignancy has been obviated through the removal of the diseased area, and for the same reason the danger of perforation, reactivation of the ulcer, new ulcers and hemorrhage are likewise avoided. While jejunal ulcers are not impossible, even after a properly performed gastrectomy in which at least two-thirds of the stomach are removed, they are exceptional instead of being commonplace as they are following gastroenterostomy. In some of the reported cases the operation was no more, or hardly more, than a pylorotomy, but improperly included among the partial gastrectomies. This is misleading inasmuch as the influence upon the acidity is under such procedures scarcely entitled to any consideration and the tendency to jejunal ulcers in some of these cases may be increased for the same reason that they are in the Von Eiselsberg pyloric exclusion.

To come within the pale of partial gastrectomy the radical surgeons insist upon the removal of one-half to two-thirds

of the stomach as the proper amount to secure the desired acid reduction if not anacidity. That gastrojejunal and jejunal ulcers are not impossible in cases where the operation was almost a total gastrectomy emphasizes the generally recognized fact that certain individuals seem to have an ulcer tendency that amounts to an idiosyncrasy. This explains the exceptions but does not invalidate the importance of those measures that are most likely to establish an anacidity as the best although not faultless course to pursue.

Some confusion has arisen and more will follow in the discussion through a careless nomenclature as regards the terms excision and resection, pylorotomy and partial gastrectomy. Reference has also been made to the possibility of the selection of easy cases for partial gastrectomy as an explanation of the low mortality. This same explanation forces itself upon one in considering a large series of gastroenterostomies with a surprisingly high percentage of cures and a surprisingly low percentage of jejunal ulcers. It seems unnecessary to add that no operator of the conservative or radical type is supposed to follow one course to the exclusion of the other.

If the subsequent complications of gastroenterostomy in the hands of trained operators are legitimately counted against those of gastroenterostomy, as they should be, and the subsequent possibilities of partial gastrectomies in the hands of trained operators counted against those of partial gastrectomy, we believe that the mortality following partial gastrectomies will be lower than that following gastroenterostomy, and the end results better, the character of the cases in each being about the same.

According to Lewisohn the mortality following partial gastrectomy in the hands of von Eiselsberg, Haberer, Freidemann and Bohmansenn is about 5 per cent and the same author refers to statistics from leading hospitals in New York City showing a mortality of 7 to 11 per cent

following gastroenterostomies for unperforated ulcers.

In 407 cases, not including those of acute hemorrhage, Finsterer's mortality was 4.4 per cent. In a series of 296 cases operated upon since 1919 he has had a mortality of 2.3 per cent; 207 cases in this series were particularly difficult. More than one-half of the stomach was removed, with a mortality of 3.3 per cent. In the last three and one-half years he has had three deaths in 158 resections, a mortality of 1.8 per cent. He emphasizes that no case died within the first few days of so-called shock of heart failure, and there was not a single death from pneumonia. Forty-three of his patients were between the ages of sixty-six and seventy-six years. This same surgeon, through a careful follow-up of his duodenal cases, claims absolute cures in 94 per cent, only 6 per cent having "slight discomfort due to ventral hernia, cholelithiasis, etc." There were no peptic ulcers.

Stress has been laid upon the removal of a seemingly unnecessary amount of the stomach for a small gastric, or, what seems even more extreme, a small duodenal ulcer. In view of our still imperfect knowledge of the subject, the question arises whether the small duodenal ulcer is the real disease or the result of the disease. If the first holds good, the dictum "moderation in all things" has a foundation; if the last, it has at best a defective foundation and is misleading. If the ulcer is largely dependent upon the hyperacidity, the removal of the ulcer without favorably influencing the provocative condition has certainly a questionable foundation.

The chief claims for gastroenterostomy have been that of drainage and the reduction of the hyperacidity. It is known that with an open pylorus the chyme by preference passes through the pylorus and not the stoma, especially if the stomach is distended. If the pylorus is closed according to the von Eiselsberg technique, the danger of jejunal ulcer, a more serious condition than the original, is considerably

increased, presumably through the shunting of acid chyme directly into the jejunum. As for the reduction of the hyperacidity, this not only fails to occur to the desired degree but with time tends to undergo diminution seriously endangering the merits of this claim; in gastrectomy the tendency is just the reverse, the reduction at the onset is decidedly more pronounced and with time increases.

The influence of hyperacidity is concurred in by all types of surgeons and internists. Further, through partial gastrectomy that portion of the stomach where the motility is greatest is removed. The resection includes not only the ulcer but also the abnormal area commonly attending gastric and duodenal ulcers.

According to Konjetzny and Calima, the pyloric half of the stomach shows evidences in ulcer cases of marked gastritis, a pathological condition favorable for trouble, and that is removed through the partial gastrectomy.

In the gastroenterological department of the Mt. Sinai Hospital between 1915 and 1920, 3 per cent of the gastroenterostomies were followed by anacidity; in the partial gastrectomy cases during the same period, there was an anacidity in 77 per cent. The experience of Lorenz and Shur in 1922 is along the same lines. The frequency of gastrojejunal ulcers in the Mt. Sinai Clinic in gastroenterostomy cases has been 34 per cent. Of these, 18 per cent were confirmed at a second operation, and in 16 per cent the diagnosis was based on clinical symptoms and roentgenographic findings (Lewissohn).

As regard the possibility of jejunal ulcers following a properly performed subtotal gastrectomy, experience based upon partial gastrectomies running into the thousands, representing a number of trained European operators and some Americans, notably at the A. A. Berg clinic at Mt. Sinai Hospital, New York, justifies the belief that their occurrence following partial gastrectomy is the exception that only proves the rule.

In the United States the majority of surgeons still favor gastroenterostomy over partial gastrectomy. In a Western clinic over 8600 gastroenterostomies (combined when necessary with excision) were performed with a claim of 95 per cent satisfactory results, with a mortality of between 1 and 2 per cent in duodenal ulcers, and if combined with cautery or knife excision, 90 per cent satisfactory results with 2 or 3 per cent mortality in gastric ulcers, plus the occurrence of gastrojejunal ulcers in about 2 per cent;<sup>1</sup> results that are practically perfect; but the number of observers who remain unconvinced that such results are possible is steadily increasing.

In the East we have another clinic of note where gastroenterostomy has been discarded in favor of gastrectomy because they were dissatisfied with their results, namely, "a perfect cure in nearly 50 per cent (47) of our cases; to this may be added a small group (19) with fair results." This same clinic was influenced in abandoning gastroenterostomy because of the disastrous gastrojejunal ulcers.

In one series of cases re-examined in this clinic after a duration of four to nine years, 34 per cent suffered from gastrojejunal ulcers of which 18 per cent were re-operated upon and in 16 per cent the diagnosis was based upon clinical symptoms and X-ray findings.

Evidently there is an error somewhere since the claims are conflicting and both cannot be right.

Incomplete as our knowledge is, it is generally conceded that ulcer cases admit of a certain degree of classification: The first is the mild type with periodic activation that apparently or actually gets well under rest and medical treatment. A second is a type in every way more pronounced and with more persistent symptoms that through a gastroenterostomy has the moderate acidity reduced, the emptying of the stomach improved and gets well or is markedly benefited.

<sup>1</sup> *Ann. Surg.* 79: 386, 1924.

There is a third type with a high degree of acidity, a tense nervous state with ulcer symptoms pronounced and frequently resorting to soda or magnesia, hypertonic throughout. This is the type that frequently remains unimproved or is even made worse. It is in this type that we may expect the gastrojejunal ulcers and other complications.

The value of the conclusions in gastro-duodenal surgery is in direct ratio to the accuracy of the follow-up system. It would require an enviable degree of optimism to think of following up 8600 or more gastroenterostomies even if they were all located in the same city, and if spread throughout the land the task of following up this large number is obviously as nearly impossible as it can be, assuming that the questionnaire system, while not without some value, is too imperfect to be seriously considered where exact discriminations are necessary.

The cases that are not cured will fall into three groups: In the first group the unsatisfactory element is such that the patients prefer to bear it rather than to invite what they believe might possibly be worse. They may or may not answer a questionnaire and with or without accuracy. A second group is decidedly dissatisfied and may return to where the first operation was performed, but being disappointed are about as likely to go elsewhere. The third group is the one in which new ulcers form, old ones reactivate or perforate, and lastly, being of the hypertonic type, are the cases more liable to gastrojejunal ulcers with perforations. When the latter complication arises, the patient is too acutely ill to be transported to the hospital where first operated upon, if this happens to be located a hundred or more miles away, and therefore falls into the hands of the local surgeon, who most likely has never been trained to

perform a gastrectomy; but is now called upon to perform a far more serious and difficult operation with the only result that one has a right to expect, and which more than likely is never reported, and therefore the gastroenterostomy statistics upon this feature and to this extent remain serenely untouched.

Since there is so much upon the subject that is still problematic, it is difficult to say what the future will reveal, but in the light of our present knowledge considering the immediate and remote consequences of gastroenterostomy and gastrectomy, the wisdom of the course seems to point to gastrectomy provided the operator has trained himself to the task.

It is difficult to avoid the conclusion that influential bodies like the American College of Surgeons are overlooking an opportunity to influence surgery favorably by urging upon medical schools, and surgeons aspiring to gastroduodenal surgery, a more extended course in surgery upon dogs. Even if a surgeon has a large and successful surgical practice it does not follow that such special training would not be attended with the most wholesome results. The technical side of surgery is an art that can no more be acquired from a piece of paper, however well written, or from extensive observation or even assistance, than plumbing, wood turning or any other art. All of them are immeasurably helpful, but after all, it is actual practice that makes true perfection, and as much of this perfection as possible should be acquired through practice upon lower animals and not human beings. When this is adopted I feel confident that there will be a swing around to gastrectomy as the choice and gastroenterostomy as the alternative and while our results may not be entirely faultless, they will at least be better than they are at present.

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# PLASTIC ORTHOPEDICS OF THE FOOT AND LOWER EXTREMITY\*

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THE disfigurement of the lower extremities may have the most unfortunate psychological effect upon individuals, especially upon women. It may produce an inferiority complex whose ramifications may be both wide and lasting to a surprising degree. Leg and foot defects may seriously interfere with social pleasure as well as with a person's attention to business and profession. In a female individual a neurosis may develop on account of ill-shaped legs or malformed feet. It is such conditions which I wish to discuss, leaving out of consideration the various and manifold orthopedic affections which have resulted secondary to a pathological process in the brain or spinal cord, as for example the acquired talipes of spastic or infantile paralysis; neither will I enter into the description of deformities secondary to local or remote inflammatory processes, such as tuberculosis or pyogenic focal infections leading to arthritides; nor will I dwell even upon the congenital foot deformities, i.e. talipes. This article is devoted to the conservative and operative correction for cosmetic purposes of common conditions which affect the leg from the knee down, conditions which offer difficulties in shoe fitting and interfere with happiness because they insult the patient's esthetic sense.

Enumerating from below upward, the most frequent affections are: (1) hallux valgus; (2) minimus digitus varus; (3) hammer and other malformed toes; (4) excessively long toes; (5) submalleolar lipomata and fat ankles; (6) bow legs; and (7) varicose veins and ulcer.

## I. HALLUX VALGUS

A mild form of this defect may respond to conservative treatment by physical

and mechanical measures. Physical modalities to overcome adhesions and contractures; massage, manipulations and muscle training to reestablish function, and padding and night splinting to retain the correction obtained by physical means may overcome many an incipient hallux valgus. The toe may be restored to a position and shape commensurate with the sensible commercial shoe. The foot may assume a presentable appearance. On the other hand, if the toe deviation has become fixed by tissue contracture and the head of the metatarsus has adopted an unsightly shape, only operative procedure can restore the configuration to the forefoot.

The varieties of hallux valgus operations are so numerous that the rehearsing of them would lead us too far. Suffice it to say that the object of all of them is to restore the contour and the function of the foot and with this, to abolish the symptoms and signs of the defect.

The type of operation must be chosen in accordance with each individual case, keeping in mind that the normal anatomical structures and the weight-bearing function of the foot should be disturbed as little as possible. For this reason the Mayo's operation should be limited to cases in which the big toe is enormously long and interferes with wearing of the commercial foot gear. Even in such instances the toe can be shortened by removing a part of the phalanx instead of the metatarsal head. The operation I most frequently perform is as follows:

A 2 in. incision is made on the outer side of the big toe joint. The conjoined tendons of the adductor hallucis group of muscles are carefully exposed and severed from their insertion at the base of the first

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phalanx. The external sesamoid is not removed, except when extremely displaced, as indicated by the roentgen ray, or when it is abnormally large or eroded. After this, the severed tendon of the adductors and the external head of the flexor brevis hallucis are transplanted into the dorsum of the head of the first metatarsal bone by means of stout catgut or silk thread. Now only is the enlarged metatarsal head exposed and the superfluous bone chiseled away. It may at times become necessary to remove a button from the base of the phalanx in order to straighten the toe. The toe position is now corrected and held in position by means of a plaster shoe or splint. Weight-bearing is allowed in about eight to ten days.

While this operation is my choice, I deviate from it whenever circumstances warrant, as indicated by the findings in the operative field and by the roentgen ray. All cases should be roentgenographed preoperatively to give a clue to the mode of operation and postoperatively to present the results. After-treatment with physical modalities and the wearing of a foot support and properly fitted shoes should always be practiced. Many well-performed operations present bad results because painstaking after-treatment has not been carried out.

## 2. MINIMUS DIGITUS VARUS

The deviation of the little toe towards the midline of the foot and the prominent head of the fifth metatarsal can be overcome by methods similar to those outlined for hallux valgus.

The conservative treatment is practically the same only that the strapping and splinting of the little toe differ from those of the big toe. These measures may suffice if the condition has not advanced too far: if the toe has not become permanently fixed in the malformed position by contractures of the joint capsule and the tendon of the dorsal flexor.

For the operative correction of the

minimus digitus varus two methods are advocated. One is as follows: A part of the head of the metatarsal and, if need be, a portion of the third phalanx are chiseled off, thus removing the offending prominence which makes the forefoot too wide. Capsulotomy and tenotomy may have to be added if the toe is dorsally flexed and contracted.

The other operation is to perform an osteotomy of the fifth metatarsal shaft and to shift the distal portion to the midline of the foot. In this corrected position the metatarsal unites. I have obtained the best results by the former method which is simple and effective.

## 3. HAMMER TOE AND OTHER MALFORMED TOES

The amputation of deformed toes should be condemned because a predisposition for much functional disturbance and for subsequent malformation is thus created. An exception may be allowed with the little toe when it is very much deviated towards the midline and when it markedly overrides or underrides the neighbor. Only after failure of conservative and operative procedures should advice be given to amputate, even in the case of a little toe. While the loss of the last toe may but rarely cause trouble, the foot has lost its normal, its natural appearance.

Toes should be restored to comparative normalcy in shape and position. The most common defect is the hammer toe. If many toes are thus deformed we have the claw foot to deal with.

Conservative measures, i.e. physiotherapy, including manual and mechanical stretching and adequate supporting, may sometimes be sufficient to give satisfactory correction of a mild hammer toe. But in more extensive deformity it is usually necessary to tenotomize or to lengthen the extensor longus tendons, to tenotomize the toe flexors and at times even to perform a capsulotomy of the metatarso-phalangeal articulations.

Tenotomy releases the tendon contrac-

tures; capsulotomy relieves the capsular shortening of the joint beyond the head of the metatarsal. There is no doubt that this simple section of tendon and capsule may suffice, if followed by the mechanical and physical measures already mentioned.

Whatever treatment is instituted it is not wise to apply much force in the manipulative correction of the toes. This may lead to swelling from rough handling, from tearing and stretching of the capsule and tendon. Not only may it result in a failure to straighten the toe, but may greatly add to the suffering of the patient and to an increase of the defect.

In cases of long standing which offer excessive resistance to manual manipulation, even after tenotomy and capsulotomy, a bone operation should be resorted to.

This consists in a subperiosteal removal of sufficient bone to allow over-correction of the toe without any force. A wedge of bone is resected from the phalangeal articulation and the bone ends allowed to unite. This is the most satisfactory procedure to abolish permanently the flexion contracture of the phalangeal hammer.

#### 4. EXCESSIVE LONG TOES

The difficulty of fitting a commercial shoe when the foot is too long on account of a protruding toe is obvious. The amputation of a terminal phalanx, as advised at times, should not be performed, it being only an additional disfigurement. A square piece of bone should be resected from the middle phalanx in the lesser toes, or from the second phalanx in the big toe. A very satisfactory and cosmetic result ensues, especially when a flap of fascia is interposed into the joint to prevent ankylosis.

#### 5. SUBMALLEOLAR LIPOMA AND FAT ANKLES

Fat lumps anterior to the external malleoli are a rather common occurrence in women. While they do not give any

subjective symptoms, they always render the ankle ill-shapen in appearance.

I have attempted to reduce these fat masses by conservative means, but never succeeded. No massage, nor any form of physiotherapy including the advocated negative galvanism, has lead to a permanent reduction of the size of these masses of adipose tissue.

Enucleation through an open incision is the only procedure which has abolished this unsightly tumor. The removal is simple and the final result is satisfactory.

Besides the submalleolar lipomata, an ankle may be large in virtue of circumferential fatness of the lower leg. By conservative means I was not able to gain any appreciable and lasting reduction of the leg contour. As conservative therapy I used the well-known *Zinkleimverband*. The technique of its use I will describe under the discussion of varicose veins. This cast or bandage may be of temporary usefulness if continued for a long time. Unfortunately the effect of this treatment is only temporary; the condition usually returns a short time after interruption of casting.

The operative removal of fat to gain a better shaped ankle in this circumferential leg fatness is still in the experimental stage. I have personal experience in only 2 cases. The site for the operation is in the midline over the tendon Achilles. The incision is about 6 to 8 in. long through the skin and subcutaneous tissues, thus exposing the layer of fat. The latter is removed by a long strip or by curettement on each side of the tendon, leaving sufficient fat on the skin so that it may present an even outline after healing. After the stitching, which should in these cases be subcutaneous, a tight compression bandage is applied and left on for at least ten days. The last word in this plastic operation of the lower part of the leg has not been spoken yet. To my knowledge, nothing has been published to date on this subject. Although I cannot with certainty advocate operative procedures for a successful



restoration of the leg outline, I think it is worth trying, since no bad effects or dangerous results can ensue.

#### 6. BOW LEGS

This type of deformity is not uncommon in the adult, although extreme bowing is relatively infrequent. After massage, manipulations and the wearing of all kinds of commercial supports have been in vain, the woman will consult the orthopedist with the request to have the legs straightened. The psychic burden is so great in this malformation that even operation is requested. To gain a good cosmetic effect it is essential to have roentgenograms taken of both legs for the sake of comparison and to determine the type of operation to be performed. Only cases with mild knock knees give promising results. Whenever the knock knees are markedly developed, straightening of the legs will result in a worse appearance of the entire lower extremity than before the operation.

The operation is comparatively simple. It consists of an osteotomy or a wedge-shaped resection of a piece of the tibia and a division of the fibula, on a little higher level than that of the tibia. In three to four weeks the plaster cast, applied immediately after the operation, is changed with the leg in better correction. An attempt at complete correction should never be made at the time of operation; the straightening should be gradual in two or more plaster cast reapplications, each time reducing the bowing of the leg until complete alignment is obtained.

The time necessary for complete recovery is from ten to sixteen weeks. If the bowing is anterior or acutely lateral a wedge-shaped resection of the tibia is indicated, while otherwise a transverse or longitudinal osteotomy will suffice. There are even cases when the fibula may be left intact, the correction being obtained with the severance of the tibia only.

#### 7. VARICOSE VEINS AND THEIR SEQUELAE

This unsightly and troublesome defect

of the leg, which occurs so frequently in women, can be overcome by a method advocated in recent years, namely the obliterative treatment of varicosities and the application of Unna's paste for the healing of varicose ulcers and superficial phlebitis, both of which are complications of the distended veins.

The formula for Unna's paste is:

Glycerin	10	parts
Gelatin	4	parts
Water	10	parts
Zinc oxide	4	parts
Glycerin	10	parts
Gelatin	6½	parts
Water	10	parts
Zinc oxide	2½	parts
Phenol	⅓ per cent of the total volume.	

A modification proposed by Dr. Joseph W. Sooy is:

Ten pounds of this paste is sufficient to make seven boots. While Unna's original paste may serve the purpose, Sooy's modification makes the dressing somewhat antiseptic and inhibits the thriving of organisms under the boot. It increases the porosity of the substance and stimulates healing of the ulcer.

Both pastes are applied in the following manner:

After the paste is prepared, it is placed in a double boiler and is heated to about 100°F. It becomes as viscous as paint. With the aid of a paint brush it is applied directly over the skin of the leg, beginning from the toes and ending below the knee. The ulcer is not protected by a dressing. A simple spiral bandage is wound evenly over the first layer of the paste; then more paste is applied, followed by another muslin bandage. A total of three layers of bandage and four of the paste completes the boot. After cooling, the boot is rubbery hard and forms a pressure bandage which in virtue of its porosity allows the discharge from the ulcer to escape.

The paste boot cannot be regarded as a permanent cure for any condition. It offers only a temporary support, decreasing the venous pressure and improving arterial circulation. It is doubtless a very efficient

measure to reduce edema of the ankle and leg and to favor the healing of the ulcers. The paste dressing can be left in place for as long as twelve weeks without renewing it.

For a permanent cure of the varicose veins the injection method may be considered the most ideal. The treatment is a radical cure. Over the operative methods it has the advantage of being an ambulatory treatment. The pathological principle underlying this method is the formation of a phlebitis of the venous wall. The injected solution acts as an irritant to the intima of the vessel and produces the inflammation, called by Siccard "endo-veinitis." Siccard describes the pathology as a phleboscrosis which actually is a productive adhesive and organizing phlebitis.

The solutions in use at the present time are 15 to 25 per cent sodium chloride, 20 to 40 per cent sodium salicylate, urea and quinine solution and a 60 per cent glucose solution. Other chemicals in solution have been used and given favorable results. The kind of medication has not been decidedly established. Individualization and establishing the proper indication for each solution should be the aim of the men who use this mode of therapy. The technique of the injection also varies somewhat. I proceed in this manner: While the patient is standing I apply a tourniquet below and above the site of the injection. With tincture of iodine I mark the point where I desire to introduce the needle. The patient then lies down and I

introduce the needle. The flow of blood indicates that I have struck the lumen of the vessel. The central bandage is loosened, the leg is raised and the solution introduced. In withdrawing the needle one must be careful not to allow any drop of the solution to infiltrate the subcutaneous tissues for fear of cellulitis, which may easily set up. A sterile gauze sponge is placed over the injected area and strapped on by means of adhesive. An elastic bandage may be applied over the entire leg and left on until the next injection, in about five days.

This method of treatment is most efficacious provided the proper indications are established beforehand and the possible complications forestalled. I do not intend to discuss these here, but desire to add that no recurrences take place. New veins may appear on the leg in a patient with varicose diathesis; in such instances the injections have to be continued into the newly formed varicosities.

It must be admitted that very small varicose veins are not amenable to this injection treatment, hence promises must be guarded against.

#### CONCLUSIONS

The enumerated defects are only the most common ones in the foot and leg. Their correction is advocated and obtainable for the sole purpose of gaining cosmetic effects and abolishing unsightly and ugly outlines of the lower extremities. The etiology and symptomatology is disregarded, having no bearing on the subject.



# ANATOMICAL VARIATIONS IN THE THYROID AS A CAUSE OF RECURRENT GOITER\*

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EARLY in the study of goiter a considerable percentage of recurrences were seen following operation. With the improvement of diagnostic ability and operative technique there was a marked decrease. Several years ago in the goiter clinic of the University of Oregon, we began the study of the cause of recurrence. We classified the patients coming in complaining of recurrence into two main groups.

- I. Pseudo recurrences
  - A. Diagnostic errors.
  - B. Symptoms due to permanent lesions
  - C. Insufficient operations
    1. Improper operations
    2. Anatomical variations.
- II. True recurrences
  - A. Without symptoms
    1. Colloid goiter.
    2. Diffuse adenomatous goiter.
    3. Adenoma.
  - B. With symptoms
    1. Toxic hyperplastic goiter (exophthalmic).
    2. Diffuse adenomatous goiter.
    3. Adenoma.

Under diagnostic errors were placed those patients whose symptoms were suggestive of goiter but were caused by other lesions. There had evidently been a goiter which had been removed without influencing the symptoms. With our present-day diagnostic methods and a proper understanding of the value of the basal metabolic rate and sufficient repetition to determine the true rate, these errors should now be minimal. Permanent lesions are the result of neglect, usually on the part of the patient but sometimes on the part of the physician. Permanent lesions in the heart, in the vascular system,

or in the central nervous system, are produced before operation and, although the patient may be cured of goiter, he will still have some of the symptoms.

Under the third group, insufficient operations, are included those patients in whom there was not a sufficient amount of the thyroid removed to produce a cure. Under this group are included as subgroups: (1) improper operations; patients under this group have usually been operated upon by inexperienced operators and not enough gland has been removed to produce a cure; (2) anatomical variations; the operation performed was sufficient for an ordinary gland but the recurrence is due to an anomalous condition.

The patients with true recurrences were divided into those without symptoms and those with symptoms. In the group without symptoms are included patients who have been operated upon and return with a goiter but no symptoms of hyperthyroidism and a normal or subnormal basal metabolic rate. In this group we have recognized: (1) colloid goiter, the most common kind; (2) diffuse adenomatous goiter, and (3) true adenoma. While the latter two groups were not toxic when we saw them, we believe in the course of time they would become toxic, so operation was advised.

*Recurrence with Symptoms.* Here are included all those patients who gave a history of cure following operation but have returned with a goiter and symptoms of hyperthyroidism. In this group we have found: (1) toxic hyperplastic goiter (exophthalmic); (2) diffuse adenomatous goiter, and (3) adenoma.

Our work upon recurrences began with the study of this latter group. We first studied regeneration of the thyroid in

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rabbits and found that, first, as long as there was a sufficient amount of thyroid gland left to supply the necessary thyroxin

num amount of gland so as to make certain that hyperplasia would take place, first, that an increase in the amount of colloid



FIG. 1.



FIG. 2.



FIG. 3.

FIG. 1. Large retrotracheal extension. Rubber tube marks position of trachea. There were bilateral retrotracheal extensions which met in midline posterior to trachea. Adjacent surfaces were flattened but not united.

FIG. 2. Retrotracheal extension. Rubber tube marks position of trachea. There were bilateral retrotracheal extensions which met in midline. Retrotracheal extension made up greater portion of both lobes so that upon exposing thyroid portion presented appeared comparatively small.

FIG. 3. Inferior extension from lower pole.

to the animal, there was no change in the gland as a result of removing a portion of it; second, that when there is a sufficient amount of thyroid left so that stimulated activity of the cells can supply enough thyroxin, there will be an increase in colloid but with no, or very limited, hyperplasia; and third, when there is not enough thyroid gland left to supply the necessary amount of thyroxin, hyperplasia takes place and new gland substance is developed. In some instances this hyperplasia was excessive.

We next undertook the study of the control of regeneration and found that when the thyroid gland was kept saturated with iodine, a greater amount of gland could be removed without hyperplasia than when iodine was withheld. We found, further, that in removing a maxi-

appeared in about two days whether iodine was given or not, second, that hyperplasia appeared in about seven days whether iodine was given or not, and third, that the hyperplasia was usually completed in three to four weeks when iodine was given but that it continued much longer if iodine was not given, and in two instances where iodine was not given the hyperplasia continued until the thyroid had assumed proportions sufficient to be called a goiter. As a result of this work we concluded that true recurrent goiters could be prevented by having the thyroid saturated with iodine at the time of operation and kept saturated for two months after the operation and giving sufficient iodine thereafter to supply that needed for normal function.

In applying this to the patients, we

found while the number of recurrences were markedly reduced there were still some patients who would have recurrences.

cause recurrences as follows: (1) persistent pyramidal lobe, (2) superior accessory thyroids, (3) retrotracheal extensions, (4)



FIG. 4.



FIG. 5.



FIG. 6.

FIG. 4. Inferior extension and extrusion from lower pole. Distal portion has adenomatous mass at its end which was connected to proximal portion by connective tissue only. There was no thyroid tissue connection. Proximal part is an extrusion that was connected to lower pole. It was a true extension of thyroid tissue.

FIG. 5. Extrusion from lower pole connected only by connective tissue.

FIG. 6. Same as Figure 5, showing flattened surface where this mass came in contact with lower pole. There was no thyroid tissue connecting the two.

About this time we saw a patient who had been previously operated upon elsewhere five times. With the ordinary methods of examination, no thyroid gland was palpable, but by standing behind the patient and pressing the fingers of the left hand posterior to the trachea so as to rotate it to the right, a mass could be felt with the thumb and finger of the right hand. Reversing the method of examination, the mass could be forced over to the left side. At operation this was proved to be bilateral retrotracheal extensions that had never been reached. Since then we have been studying every patient that comes to operation for atypical thyroid distribution.

As a result of this study we have classified the atypical conditions seen that may

inferior extensions or extrusions, and (5) lateral extensions or extrusions. Pyramidal lobes appear to be present more frequently than any of the others. The pyramidal lobe is formed by a spreading out of the thyroglossal stalk above the isthmus at the time of the development of the thyroid. It is usually connected by its base to the isthmus but sometimes is independent of the isthmus. It may extend as high as the hyoid bone. At the time of the primary operation the pyramidal lobe may be so thin that it may be overlooked or the surgeon may think it of no consequence. Whenever present, however, it should be removed as it participates in the regenerative process and may form an unsightly mass even though it does not develop into a toxic goiter. Aberrant thyroid masses

originate from the thyroglossal stalk above the hyoid bone and usually lie along the former course of the thyroglossal duct. They are sometimes displaced laterally, but I have seen none of them in my series.

Retrotracheal extensions (Figs. 1 and 2) occur much more frequently than are supposed. This is a congenital condition which, like the pyramidal lobe, occurs so frequently that it can hardly be said to be anomalous. I have seen retrotracheal extensions that will measure as much as  $2\frac{1}{2}$  cm. in their anterior posterior diameter. Retrotracheal extensions are frequently bilateral and often meet posterior to the trachea so that the trachea is completely encased in thyroid tissue. At the place of contact the border of each is flattened and when large there is a wide flattened surface. I have never seen them united. The trachea may be compressed. These patients often complain of a tightness in the throat even when no evidence of constriction is seen. In the larger ones the esophagus is pressed against the posterior wall and the patients may complain of dysphagia. At operation every lobe should be everted before removal in order that a retrotracheal extension may not be overlooked. Owing to the close proximity of the recurrent laryngeal nerve, the best method of removing retrotracheal extensions is to evert the gland, place two fingers back of the retrotracheal extension and then, after the capsule of the gland has been opened and the greater portion of the thyroid has been dissected free from the posterior section of the capsule, the retrotracheal extension is inverted into the capsule so that it may be dissected out without injury to that portion of the capsule which covers the nerve. If overlooked, a subsequent operation is fraught with danger due to displacement of the recurrent laryngeal nerve in the healing process. As the scar forms it may be drawn over the top of the remaining portion of the gland.

*Inferior and lateral extensions or extrusions.* There have been several articles in the literature reporting altogether

between thirty and forty lateral accessory thyroids. I have recently gone over all of this literature and am trying to get



FIG. 7. Lateral extrusion. Thyroid is made up of adenomatous masses. One held out by needle had been extruded and detached with exception of remaining portions of capsule. There was originally more of capsule present than shows in picture, capsule having been broken in handling previous to taking of picture.

later reports on as many as possible. The result of this study will be reported in a subsequent paper, but suffice it to say here that this group can be divided from the reports into (1) atypical thyroid lobes, (2) metastatic carcinoma, and (3) independent thyroid tissue. In our work we have found no inferior or lateral accessory thyroids independent of the thyroid gland, but we have found both extensions, (Figs. 3 and 4) and extrusions (Figs. 5 and 6). The inferior extensions begin usually as an adenomatous mass at the lower pole of one of the lobes. As the mass grows it forges outward from the pole similar to a subserous fibroid of the uterus. As it continues to grow, that portion that has been extruded may grow more rapidly, giving it a pedunculated appearance. As the process continues, it draws out more and more so that the thyroid tissue of the peduncle becomes thinner and thinner

until sometimes the thyroid tissue separates, leaving the mass independent of the thyroid gland except for its connection by the capsule. The capsule may then thin out until there is only a connective tissue band binding the extruded mass to the thyroid gland. I have never found one of these separate masses that was not connected to the main gland at least by the remainder of the capsule, but I do not doubt that it does occur, particularly in those extensions downward into the chest. I believe that those independent thyroid masses found in the chest have developed in this manner. This process of development is similar to the development of the subserous fibroid which sometimes becomes detached and lies in the abdomen free from the uterus.

The so-called lateral accessory thyroids that are non-malignant develop, I believe, in the same manner from either the upper pole or lateral aspect of the lobes. I have seen one instance of a lateral extrusion (Fig. 7) in which the capsule had nearly disappeared and only a thin connective tissue band remained. Had this patient not been operated upon at this time and had the mass later taken on a more rapid growth, this band would probably have given away, leaving it as an independent body which would then have been looked upon as an accessory thyroid.

A study of the embryology of the thyroid gland reveals no method, or mechanism by which thyroid tissue can be produced except from the anlage at the base of the tongue as the existence of other anlage has been disproved. Thyroid tissue may develop from any portion of the thyroglossal stalk. The superior accessory thyroids form from this stalk anywhere from the base of the tongue to the isthmus. They sometimes migrate laterally so that they are not always found in the midline.

Theoretically the stalk might project downwards beyond the isthmus. I have seen small tongue-like projections on the lower border of the isthmus that are

suggestive of this. In one instance (Fig. 3) I thought at first that the extension from the right lower pole might be due to such a continuation of the growth of the stalk, but it was adenomatous and as the extensions or extrusions are usually adenomatous, I doubt this very much.

In operating it is essential that the surgeon remember these anatomical variations, as I have personally seen recurrences in each of the types I have described. The retrotracheal extension is usually, if not always, of the same type as the main portion of the lobe to which it belongs and the extensions and extrusions are usually adenomatous so that the leaving of these means the leaving of masses of pathologic tissue. The pyramidal lobe may show the same pathologic change as the majority of the gland or may be normal. It should not be left, however, even if normal, as it very frequently undergoes hyperplasia following operation if left. I have seen well-marked toxic hyperplastic (exophthalmic) goiter from a pyramidal lobe left at a previous operation.

If all but a very minimal amount of thyroid tissue be removed at operation, if the anatomical variations are looked for and removed when present, if the thyroid gland is saturated with iodine at the time of operation and kept saturated during the period of regeneration (probably two months), and if the patient gets a sufficient amount of iodine thereafter to insure normal thyroid function, there will be no type of surgery giving more satisfactory results than thyroid surgery upon carefully selected, carefully prepared goiter patients.

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# A NEW AND EFFICIENT RECTAL ANESTHESIA\*

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TWO important events have marked the history of anesthesia during the last century; the introduction of ether and chloroform narcosis and the use of local anesthetics. The latter have not realized the hope once entertained that they would replace the inhalation anesthetics.

From the standpoint of toxicity, it is true that local anesthesia has definite advantages over the more hazardous narcosis. On the other hand, the risk of psychic insult to a conscious patient during a major operation is so great that the majority of surgeons do not dare to expose a sensitive person to such a possibility. Consequently, most operations are still done under general anesthesia. It is hardly necessary to state the disadvantages of the inhalation method. Hence, the attempt to apply the anesthetic by another route than the lungs was quite natural. At present, intravenous injection may be dismissed from consideration because this method has not passed the experimental stage.

Roux was the first (1846) to show that general anesthesia may be induced by injecting water-ether solutions into the rectum. The injury to the mucous membrane of the lower colon and rectum which resulted caused him to abandon the experiments immediately. Not more fortunate was Pirogoff (1847) who gave ether vapor rectally. Consequently, interest in rectal anesthesia declined until revived by Gwathmey. The latter's publication on ether-oil anesthesia by rectum (1913) made the surgical world realize anew the possibility of eliminating the disadvantages of the inhalation method. But reports from various sources refer to severe intestinal irritation, profuse diarrhea, attacks of pain, and sometimes

serious degeneration of the liver cells. Nevertheless, the technical advantages of the rectal method and the fact that the patient is spared the stage of excitement and the risk of postoperative pneumonia, made it worth while to continue the experiments. It was hoped that there might be discovered a preparation with a wide margin of safety which would not irritate the mucous membrane nor increase the danger of general anesthesia, and which would permit the performance of almost any operation. Such a preparation has been recently found in avertin.

Avertin, chemically known as tribromomethylalcohol, was produced by Willstaetter and Duisberg through the reduction of bromal by means of yeast. It is a white crystalline substance, which sublimes easily and has a melting point of 79 to 80°C. In water of 40°C. (104°F.) it dissolves to the extent of 3 per cent. Avertin is sensitive to light and air, and if heated above 40°C., hydrobromic acid is split off and dibromacetaldehyde is formed. The latter product is a severe irritant to the mucous membrane of the colon.

According to the investigation of Straub, the mucous membrane of the colon absorbs avertin more rapidly than water. Consequently, the percentage of the drug in the enema decreases very quickly. To determine the rapidity of absorption, Straub injected a solution of avertin in doses of 150 mg. per kilo of body weight into the rectum of three persons and withdrew the fluid at different times. An analysis of the fluid yielded the data shown in Table 1.

These figures show that in about ten minutes half of the quantity of avertin is absorbed, and after about twenty minutes, three-fourths is absorbed. The

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TABLE I

Case No.	Quantity Injected		Elapsed Time (Min.)	Quantity Withdrawn		Quantity Absorbed			
	Volume of Solution (C.c.)	Amount of Avertin (G.m.)		Volume of Solution (C.c.)	Avertin Content (Gm.)	Water		Avertin	
						Volume (C.c.)	Per Cent	Amount (Gm.)	Per Cent
1	305	9.1	13	220	4.1	85	27	5.0	55
2	360	10.8	25	240	1.52	120	33	9.3	86
3	300	9.0	120	29	0.53	261	78	8.5	95

remainder of the drug requires considerably more time to be taken up in the rectum, for even after two hours from 5 to 10 per cent can be recovered in the withdrawn fluid. From this analysis it can also be seen that the absorption rate of water is not parallel with that of avertin, but much lower. Furthermore, if after fifteen or twenty minutes complete anesthesia is

cent of avertin in the urine within the first twenty-four hours. Traces were also present in the perspiration, but no bromine could be found in the expired air and feces.

*Dosage.* To determine the amount of avertin necessary to produce perceptible results, tests were made on rabbits, dogs, cats and mice, and finally on human beings, as outlined in Table II:

TABLE II

DOSE, IN MILLIGRAMS PER KILO OF BODY WEIGHT

Species	Oral	Intravenous	Subcutaneous	Rectal
Rabbit	200-300: Sleep 400-500: Sound sleep 60-160: Anesthesia 200: Lethal dose	50: Sleep 80: Anesthesia 120-150: Lethal dose	150: Light sleep 500: Anesthesia	150: Sleep 200: Deep sleep 300-500: Anesthesia
Dog	.....	120: Anesthesia	.....	500: Anesthesia
Cat	100: Anesthesia 150: Lethal dose	100: Anesthesia	.....	.....
Mouse	500: Deep sleep	120: Anesthesia	500: Anesthesia	300-500 Anesthesia
Man	50: Deep sleep	.....	.....	80-150: Sleep— Anesthesia

not established, there is little chance that it will occur subsequently because of the relatively low concentration of avertin in the unabsorbed solution. However, by individualization of dosage, based upon the physical condition and the constitution of the patient, the writer has never experienced any difficulty in inducing complete anesthesia.

*Elimination.* Avertin is eliminated by the kidneys and appears in the urine as a glucuronic acid combination which is formed in the liver. Straub found 68 per

These figures demonstrate that in human beings 80 mg. per kilo is enough to induce sleep, but to produce complete anesthesia, 100 to 150 mg. have been given. In the earlier clinical trials, 150 mg. per kilo was considered the standard dose. However, as I have stated before, the best results are obtained by individualizing rather than by adhering to a fixed dose. Time and again, to obtain full relaxation, I have given to children and women of strong constitution as high as 175 mg. per kilo, and to vigorous men as high as

185 mg. without any bad effects. It is now generally advocated that avertin be used only as a basal anesthetic in doses of 80 to 100 mg., supplemented with ether or nitrous oxide and oxygen. I do not favor this method for major operations, although it may prove of value for minor surgical procedures.

*Psychological Action.* Within four or five minutes after avertin is given, the patient becomes drowsy, yawns a few times, closes the eyes and begins to sleep. In six to seven minutes, the conjunctival and corneal reflexes vanish (a very characteristic sign) and the pupils gradually contract, being narrowed to the greatest extent in ten to twelve minutes. Meanwhile, the muscles relax, the tendon and periosteal reflexes disappear, consciousness is lost and the stage of complete anesthesia supervenes. The effect of avertin upon the respiration is characteristic. As early as two or three minutes after the injection, the respirations become increasingly superficial and less frequent. The patient's face shows a slightly bluish tint and becomes more or less cyanotic after seven to ten minutes. Then automatically, through the accumulation of carbon dioxide in the blood, the respiratory center is stimulated, the rate and volume of respirations increase, the cyanosis disappears, and with very few exceptions the breathing remains normal during the entire operation. In animals, a complete paralysis of the respiratory center has been observed only after very large doses.

A narcotic dose does not produce very marked changes in the cardiac and circulatory system. At first the blood pressure drops from  $10^{\circ}$  to  $15^{\circ}$  and the pulse becomes somewhat slower. During and at the close of the operation the rate and volume of the pulse increase and return to the preoperative level, and sometimes even a little above it. An overdose reduces the blood pressure considerably and may be followed by collapse. Avertin has a slight antipyretic action.

Avertin has very little, if any, influence

upon the other organs of the body. When it is given with the necessary precaution the rectal mucous membrane is never affected. That this is true was demonstrated in the psychiatric clinic of Marburg. In this institution 15 maniacal patients were kept in a condition of drowsiness or sleep for two to ten days with avertin without any ill effects, although as much as 200 gm. was administered to some patients in divided doses. However, when avertin solution is overheated or otherwise decomposed, its injection may produce severe injury to the rectal mucous membrane. Several cases of death from this cause have been reported in the German literature. Bacteriologic tests have shown that avertin is strongly antiseptic, *Bacillus coli* and *staphylococcus* being killed in one minute by a 3 per cent solution.

*Margin of Safety.* The factor of safety in inhalation narcosis is the possibility of immediately suspending administration of the anesthetic and increasing oxygen intake when dangerous symptoms develop. This is impossible with avertin. Once given it would help very little to withdraw the remaining fluid and wash out the rectum in case of ill effects, for absorption takes place very rapidly. The safety of the drug therefore is dependent upon the relatively large margin between narcotic and lethal doses. Comparative experiments on mice with ether-oil and with avertin solution gave the following results: Of 10 mice receiving 0.5 c.c. of 50 per cent ether-oil solution rectally, 2 stayed awake, 6 were anesthetized and died, 2 were anesthetized and survived. Of 10 mice receiving 0.25 c.c. of 3 per cent avertin solution rectally, all were anesthetized and survived. A dose of 0.5 c.c. of avertin solution was necessary to cause death. Hence the lethal dose is twice the narcotic dose.

*Preoperative Treatment.* The night before the operation, the patient is given a cleansing enema, as it is considered important that the colon be thoroughly emptied.

In emergency operations, as acute appendicitis, this measure has often been omitted by the writer and some German surgeons without bad effects during or after the operation. To secure a good night's rest the patient receives 5 grains of veronal in the evening. Half an hour before the anesthesia, morphine sulphate ( $\frac{1}{4}$  grain) and atropin sulphate ( $\frac{1}{150}$  grain) may be given.

*Preparation of Avertin Solution.* Twenty minutes before operation the solution of avertin is prepared as follows: The required dose is weighed out, allowing 150 to 175 (or even 185) mg. per kilo of body weight. The powder is dissolved in enough sterile water at 40°C. (104°F.) to make a 3 per cent solution. These figures may be confusing to anyone not accustomed to the metric system but are easily understood if one remembers that an avoirdupois pound is about 10 per cent less than a metric pound, and that 2 metric pounds make 1 kilo. For example, suppose a patient weighs 129 pounds avoirdupois. This is equal to 129 minus 12 or 117 metric pounds, or 58.5 kilos. Taking 150 mg. of avertin per kilo, multiply 58.5 by 150 equals 8775 mg., or 8.775 gm. To make a 3 per cent solution with this dose requires 285 c.c. of water. After the solution has been prepared, it is tested as follows, to determine whether decomposition has taken place. Pour 5 c.c. of the solution into a test-tube and add 1 or 2 drops of Congo red solution, 1:1000. The avertin solution assumes an orange red color, and any change into blue or violet indicates that decomposition has occurred. If decomposed, the avertin solution should be discarded.

*Method of Administration.* The patient is placed on the left side, a rectal tube (lubricated with plain vaseline) is inserted, and the fluid is slowly injected into the rectum with a large syringe. During the act of injection, the tube is pushed upwards into the sigmoid, and the patient is advised to take a few deep breaths. This

procedure prevents the expulsion of the enema.

Without a stage of preliminary excitement, drowsiness ensues which gradually deepens into a profound sleep during five minutes. The respiration at first becomes irregular and slower, dropping to about 16 per minute. The face appears slightly cyanotic. In rate and quality the pulse is not materially modified. After fifteen or twenty minutes, if the full anesthetic dose has been given, the patient is completely relaxed and ready for any operation. According to my experience, women are more easily anesthetized with avertin than men or children. In this respect, there is no difference with ether, chloroform and gas anesthesia. Alcoholics require a larger dose.

*Postoperative Period.* The duration of the operation may be extended to two or three hours without unfavorable reaction. Soon after the operation, the patient awakes, but generally falls immediately into a sound sleep. This lasts from two to three hours and on awaking the patient feels very comfortable, is free from nausea and can take fluids without vomiting. It has also been noted that in abdominal operations there is less tendency to flatulence after avertin than after ether, chloroform or gas. Of course, the patient has to be watched during the entire period of anesthesia, to prevent the tongue from slipping back.

*Author's Experience.* My observations comprise 200 patients, of whom 100 were anesthetized while I was doing postgraduate work at the University Gynecologic Clinic, Berlin, during 1927. The remaining cases were observed in this country, 33 in my own surgical service and 67 in the service of Drs. W. Bruce Anderson and George Reitz of Brooklyn, N. Y. The character of the latter 100 operations was as follows: appendectomy (acute and chronic cases) 16; vaginal operations (reparative and plastic) 12; gall-bladder operations 12; hysterectomy

11; tonsillectomy 10; removal of ovarian cysts 8; suspension of uterus 5; hernia operations 4; thyroidectomy 4; operations for extensive abdominal adhesions 3; amputation of breast 3; excision of carbuncle (diabetic) 3; vaginal sterilization 2; extrauterine pregnancy 2; cesarean section 1; amputation of leg (diabetic) 1; rib resection 1; hemorrhoid operation 1; exploratory laparotomy 1.

Only 6 of these patients vomited after the operation. In one case, on the day after exploratory laparotomy for a diffuse inoperable cancer of the uterus and intestines, the woman developed paralytic ileus from which she recovered but died three months later. The second case,

amputation of the cervix and vaginal repair, was that of a highly nervous woman who began to vomit after intake of food on the second day. The third case was one of ruptured appendix with localized peritonitis; vomiting persisted for three or four days. The remaining 3 cases were the first in the service of Drs. Anderson and Reitz. These surgeons have been accustomed to give a retention enema of glucose and saline immediately after operation. As avertin is eliminated in the form of glucuronic acid, it seems that the additional glucose produced a certain degree of toxicity, because after discontinuing this practice their patients did not vomit. There were no deaths from avertin.

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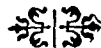
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# NEW INSTRUMENTS

## EXPERIENCES WITH A NEW BABY CYSTOURETHROSCOPE\*

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NEW YORK

EARLY in the work of our Children's Urological Clinic we encountered numerous cases of nocturnal incontinence and occasional cases of frequent urination, all with clear and uninfected urines, which did not respond to the usual methods of treatment. We cystoscoped as many of these children as the parents would permit and in every instance found definite changes at the bladder neck. These changes were thickening, infiltration and cystic masses at the anterior vesical neck with varying amounts of residual urine.

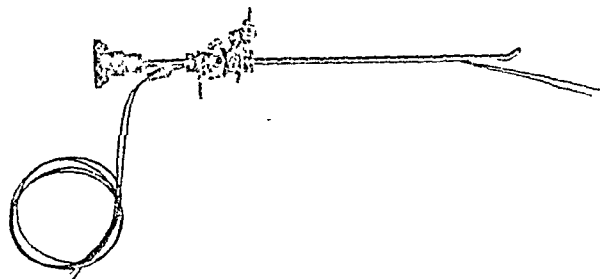


FIG. 1.

The necessity for intimate study and treatment of the child's vesical orifice, and the urethra in its entirety, led us to devise a new instrument for this purpose. This new baby cystourethroscope is 15 F. in size and has, in addition to a catheter outlet, a slot adjacent to the objective and light through which these areas may be studied and treated. With this instrument we can examine the entire urethra, double catheterize the ureters and use a fulgurating or cutting current.

The vesical orifice findings in 5 cases were as follows:

CASE I. Male, aged twelve, life-long enuresis. Did not respond to the usual measures. Cystourethroscopic examination showed a rough, irregular, thickened anterior vesical orifice studded with tiny cysts.

CASE II. Male, aged five, obstinate enuresis. The anterior vesical neck is thickened and notched. Relieved of enuresis by this procedure.

CASE III. Male, aged eleven, obstinate enuresis. The vesical orifice anteriorly is irregular, thickened and notched.

CASE IV. Female, aged eleven, obstinate enuresis and day frequency. The vesical orifice is thickened, irregular and edematous.

CASE V. Male, aged six, obstinate enuresis. The vesical orifice is thick, irregular and edematous.

This approach to the problem of enuresis is from a new angle. It is suggestive that all cases of obstinate enuresis examined showed definite changes at the vesical neck. These changes are somewhat similar to those found in adults with nocturia. It is also significant that a certain percentage of patients are cured merely by the dilatation of the cystoscopic examination. Further use of dilatation and fulguration is contemplated.

Our interest in this group of cases lies in the fact that 37 per cent of the children applying for care complain of bed-wetting. While it is acknowledged that the condition disappears in the majority of cases after puberty, it is trying for the child from the social aspect and for the mother from the standpoint of added care. It is often of economic importance as many children in orphanages are not adopted by reason of this ailment.

We hope to find through these new studies some common factor in nocturnal incontinence that will be of service in controlling the condition. We have not as yet seen a sufficient number of cases for us to draw any conclusions either as to the cause of these vesical neck changes or as to their relief.

\* Read before the Section of Genito-Urinary Surgery, N. Y. Academy of Medicine, May 15, 1929.

## CASE REPORTS

### ROENTGEN-RAY SHADOW RESEMBLING RENAL CALCULUS CAUSED BY PAPILLOMA OF THE SKIN\*

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THIS brief report is presented to emphasize the fact that papillomata, warts and fibromata of the skin may cast shadows resembling calculi. A characteristic which may help to identify them is that these shadows have extremely sharp margins, due to the fact that they are in contact with the film. Two similar cases were reported by Melicow and Gile<sup>1</sup> in 1927; and Cabot,<sup>2</sup> Pirie,<sup>3</sup> and Holmes and Ruggles<sup>4</sup> have cautioned us to inspect a patient's back for abnormalities of the skin before referring him for roentgenography.

#### CASE REPORT

A. G., aged thirty-six, was referred to me to differentiate between a diagnosis of renal and gall-bladder calculus.

*History.* Chief Complaint, pain in right lower back. Former history negative. Two years ago patient had some pain in left chest and roentgenograms then showed lungs affected by "bad cold."

*Present Illness.* During past four or five years patient has had pain in right lower back region. Slight pain constantly present and about every six months pain became so severe that patient would go to bed for a week. The pain would then ease up. No nausea or vomiting, no jaundice or blood in stools. There has been some radiation of pain down into right groin. No frequency or dysuria. For past seven weeks pain has been constant and severe and has required constant rest in bed, and has prevented sleep at night.

*Cystoscopic Examination.* Negative except that the cultures showed a bilateral staphylococcus infection. Functional tests were normal.

*Pyelogram Report.* Right kidney shadow

is normal in size and a little low in position. Left kidney shadow is normal in size and in fair position. There is a shadow as large as



FIG. 1.

the end of one's index finger in contact with the end of the right catheter, apparently in the pelvis of the kidney. Kretchmer double exposure, the shadow seen moving with the end of the catheter. This shadow is covered by the pyelogram and apparently is in the pelvis of the right kidney, as there is thickening of the shadow in that region. In the erect posture, it is more clearly seen in the pelvis of the right kidney, and is apparently too large to pass. There is a kink of the ureter at the ureteropelvic junction. Suggestion: Removal of stone under regional anesthesia.

No stone was found at operation, so later a papilloma was removed from the patient's back, and roentgenographed. This proved to be the shadow shown in the previous films.

\*Read before the Section of Genito-Urinary Surgery, N. Y. Academy of Medicine, May 15, 1929.

*Pathological Report* (Dr. Dalldorf): Skin papilloma. Specimen consists of two small pieces of yellow fatty tissue covered with from pressure, as it cast a similar shadow when excised, and it was not caused by increased melanin, but was caused either



FIG. 2.



FIG. 3.

what appears to be epithelium. Microscopic study shows the tumor to be a simple papilloma. Melanin is of normal or less than normal amount and there is none found in chromatophores, it being in the basal cell layer entirely. Therefore do not believe pigment can be responsible for roentgen-ray shadow. The stalk is composed of heavy collagen, however, and this may be the explanation.

#### CONCLUSIONS

1. Skin lesions may cast shadows resembling calculi.
2. The shadow cast by this papilloma was not caused by density of air around it

by the collagen stalk or reduplication of epithelial layers.

3. Stereoscopic plates would be helpful in locating the exact position of doubtful shadows.

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# KIDNEY RESECTION FOR SACCULATED CALYX\*

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PATIENT, Mrs. E. W., referred by Dr. H. M. Lefferts, thirty-seven years of age, married, consulted me on September 22, 1927 with a chief complaint of persistent gross hematuria.

*Family History.* Mother died of pulmonary tuberculosis.

*Previous Personal History.* Hysterectomy performed seven years ago and had not menstruated since that time. Appetite, fair; bowels, regular. Had lost a few pounds in weight. Painless hematuria of short duration and moderate amount noted at intervals since 1917.

*Present Trouble.* Began about three years ago with profuse hematuria lasting about seven weeks. At that time, she consulted a leading urologist in one of our great Western cities, where she was confined to the hospital for a considerable time, cystoscoped and thoroughly studied. The records of the work done at that time showed practically negative findings throughout, excepting that some lengthening of the upper calyx in the left kidney was noted. From what she could learn, no definite diagnosis was made. Following this, seven or eight renal lavage treatments were given with silver nitrate, which finally controlled the hematuria for a period of almost a year. At that time the bleeding came from the left kidney. Since December 1926, she had persistent attacks of frank hematuria with increasing general weakness. There were no other urinary symptoms nor backache present. She had been confined to bed for the past week with a more severe attack of bleeding and pain in the right kidney region which radiated to the right groin.

*Physical Examination.* A fairly well-nourished patient, although she was rather pale.

Abdominal examination showed no evidence of renal enlargement or tenderness on either side, or any abdominal masses. The general examination was otherwise essentially negative.

*Cystoscopy.* This was performed at the Long Island College Hospital on the following day. The bladder was normal; blood-stained urine was seen to come from the right ureter. Ureteral catheters passed freely to both renal

pelves without obstruction, with intermittent return flow of urine from both sides; that from the right was bloody, that from the left, clear.



FIG. 1. Pyelogram of left kidney (taken in 1924) shows slight dilatation of superior calyx. This appears a little less pronounced than our own taken in 1927.

Function tests showed good elimination of phenolsulphonephthalein and urea from both kidneys, although somewhat better upon the right than on the left. There were occasional pus cells. In view of the history, double uretero-pyelograms were taken in the same sitting. These revealed a curious sac-like formation in the upper poles of both kidneys, much more marked on the right than on the left and communicating with an upper calyx. The Wassermann test was negative, and the blood chemistry was normal. There was a leucocytosis of 14,000 with 80 per cent hemoglobin. A provisional diagnosis of hemorrhagic cyst of the kidney was made.

In view of the persistence of hematuria and the duration of symptoms, open operation was advised. In this the patient concurred.

Operation on the right kidney was performed three days later. The kidney was exposed and

\* Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, April 17, 1929.



easily delivered by the retroperitoneal route. The upper pole was found to be distinctly engorged with blood as compared with the

plain catgut were passed behind the edges of the cut surface. The capsule which had been dissected away was then sutured over



FIG. 2. Left pyelogram, September 22, 1927, shows sacculated, elongated superior calyx. Pyelogram almost identical with that taken in 1924.



FIG. 3. Right pyelogram, September 22, 1927, shows sacculated, superior calyx, which was removed at operation.

rest of the organ. As it was thought we might be dealing with a hemorrhagic cyst, no incision was made into this area because of increased danger from hemorrhage. It was considered more advisable to make a clean, transverse, horizontal incision through the entire upper pole at a level of the lower boundary of the sacculated area seen in the pyelogram. The incision, when completed, removed approximately  $\frac{1}{3}$  of the kidney substance, and came above the attachment of the pelvis at the internal border. Pressure upon the pedicle aided in control of bleeding, and persistent firm manual pressure with hot lap sponges completely controlled the ooze from the surface while four mattress sutures of No. 2

the raw surface, leaving a small opening for drainage. No sign of a calyx was seen on the cut surface before whipping over the capsule. The wound was closed in the usual manner, with drainage, taking one hour and fifteen minutes for the entire procedure. After removal, the sacculatation in the upper pole was found filled with blood and blood-clot, with the lining membrane distinctly hemorrhagic.

*Convalescence* was uneventful and she left the hospital, healed by primary union, approximately three weeks after operation. There was slight urinary leakage on the dressing for a few days after operation only. Excepting for a transitory tinge of blood in the urine occurring a short time after leaving the hospital, there

has been no recurrence of symptoms up to the present time, which is approximately eighteen months since the operation. The

calyces. Several small gray-white patches in the cortex suggest tubercles or small abscesses. Microscopic: Tissue is edematous. Along the

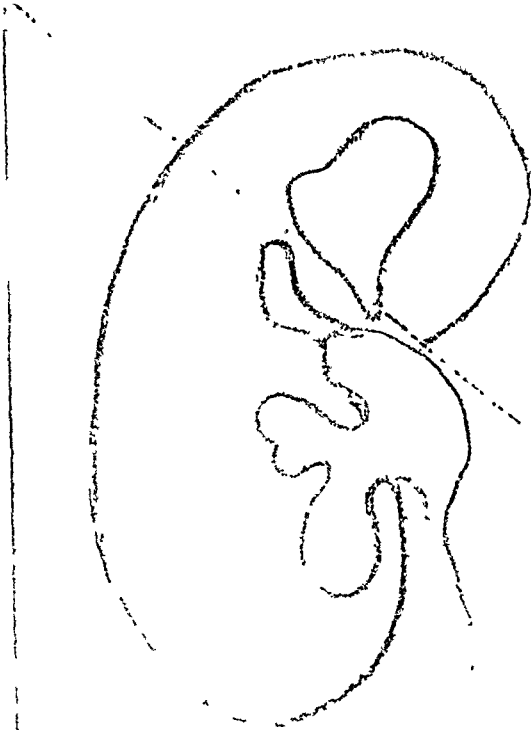


FIG. 4. Sketch of kidney showing superior sacculated calyx with dotted line indicating approximate line of amputation.

patient is enjoying excellent health and has gained about 25 lb. in weight. Several urinalyses have also proved entirely negative.

On January 15, 1928, complete cystoscopic examination at the Hospital revealed a normal function of both kidneys, and pyelogram of the right side showed complete absence of the pouch-like area described. There was some rotation of the lower pole away from the mid-line.

A description of the gross and microscopic examination of the portion of the kidney removed is as follows: Gross: The specimen consists of the upper pole of a kidney. The surface is intensely hemorrhagic. On section, the pelvis is dilated and the pelvic lining is thickened and shows small hemorrhagic areas. Pouch-like dilatations extend up into the



FIG. 5. Right pyelogram, January 15, 1928, four months after operation, shows absence of sacculated, superior calyx with some rotation of the kidney, the lower pole away from the mid-line.

cortex are sclerotic areas in which glomeruli are hyalinized and the tubules replaced by fibrosis. Occasional large zones of interstitial hemorrhage are found. The tubules of these areas are filled with blood and occasionally the capsular spaces contain blood. Throughout the tissue, the tubules show marked, cloudy swelling. There is a good deal of infiltration by pus cells, hyperplasia cells and lymphocytes. The lining of the calyces is thickened and infiltrated with large numbers of plasma cells and lymphocytes and occasional polymorphonuclears.

Diagnosis: Subacute Inflammatory Process.

I wish to emphasize the statement of the pathologist that there is no finding of glomerular nephritis.

The report of the radiologist is as follows: "Examination of the K. U. B. tract with opaque ureteral catheters in place on both sides. The catheter on the right side extends up to the upper level of the third lumbar vertebra. The catheter on the left side extends up to the upper level of the fifth lumbar vertebra. Right kidney appears to be normal in size, outline,

and position, no definite evidence of calculi. Left kidney appears similarly normal. Pyelography on the left side shows the kidney

in the upper pole, however, was absent and there was some rotation of the lower pole away from the mid-line.



FIG. 6. Epithelial lining of calyx, showing infiltration of epithelial and subepithelial tissue with subacute inflammatory cells. Epithelium at this point is hyperplastic.

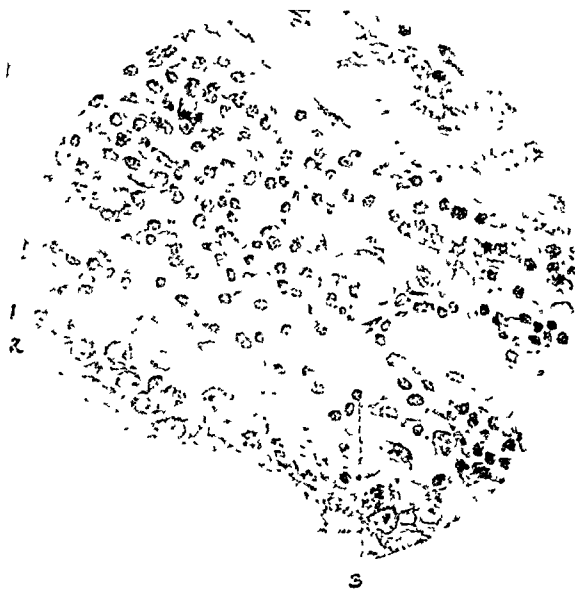


FIG. 7. Showing same changes as in Figure 1, but individual cells are well shown to be (1) clasmotocytes, (2) plasma cells, (3) lymphocytes. In central capillary are margined leucocytes.

pelvis to be well filled throughout. The upper calyx shows a distinct narrowing near its base, while distal to this point there is definite enlargement and dilatation of the calyx. The rest of the calycal markings appear normal. Ureterogram negative. Pyelography on the right side shows a similar constriction near the base of the upper calyx with very marked and definite dilatation and enlargement of the calyx. The upper calycal markings show some blunting and slight clubbing. There is a small constriction in the upper ureter just below the ureteral pelvic junction. Below this, the ureter appears negative except that it is, perhaps, a little larger than is usual. Conclusions: apparently there is a congenital anomaly present, causing a constriction of both upper calyces with some dilatation. This is most marked on the right side. Right side also shows some evidence of old, chronic pyelitis."

Pyelogram of the left kidney, taken in 1924, showed a moderate degree of dilatation of the upper calyx closely similar to the one taken by us in 1927.

The pyelogram taken in January, 1928 showed a similar outline to that taken in the first sitting prior to operation. The sacculation

#### COMMENTS

After reviewing the English literature, we find the report of a closely similar operation successfully performed by Lower in 1924 for what he termed "hydrocalyx due to infundibular stricture." Persistent renal pain was completely relieved; there was no hematuria. A unique case was reported two years later by Caulk, in which he successfully resected a dense, strictured area blocking a superior calyx with relief of pain and without removing any of the upper pole of the kidney. Almost at the same time that my case was operated on, Papin independently resected the pole of a kidney in two cases for a similar condition. These were reported in 1928.

It would appear as though we are coming more and more to the proposition of successfully employing partial operations upon the kidney. The bugbear has been, chiefly, the risk of secondary hemorrhage, and also, to some extent, the possibility

of persistent urinary fistula. The recorded work which has been done along this line in recent years has been particularly successful, and refinements of technic should soon bring us to a point where these dangers are greatly minimized. Even in horseshoe kidney we find, in a series of 52 heminephrectomies collected by Rathbun, only 8 deaths. These included, also, a number which occurred in the days before perfected pyelographic methods. The blood supply at the time of operation must be carefully studied, especially in the presence of double, fused or horseshoe kidney. The danger of infection in these cases is greater than in single or double kidney.

It is obvious that the diseased portion must be distinctly confined to one segment and that infection may be spread to the remaining portion. For this reason, many failures resulted in the earlier years, when attempts were made to save a part of a tuberculous kidney. It is emphasized by Judd that the incision should be carried through normal tissue, leaving a portion attached to the diseased segment. This seems only logical.

It is possible that, in our case, a wedge-shaped incision may have been employed but, as stated, we purposely avoided this because of the possibility of extensive hemorrhage if we had encountered a hemorrhagic cyst. Dr. Eisendrath recently discussed an instance in which he successfully removed a small sacculated calyx containing a round calculus with a small portion of kidney tissue, by a wedge-shaped incision through the cortex. This suggests also the part that a stenotic calyx may play in the persistence of infection or formation of calculi. Another field for partial resection is the removal of solitary or hemorrhagic cyst. It is possible, also, that this operation may be applied to infected pouch-like areas resulting from the later effects of kidney injury. Young, in 1917, stated that he believed that he performed the first resection where it was deliberately determined to carry out the

operation after pyelographic study, in a case of double kidney. Two years later, Koenig reported a successful case of



FIG. 8. Collecting tubules are dilated and contain blood and pus cells. Lining epithelial layer is flattened. Intervening stroma is hemorrhagic and infiltrated with lymphocytes and scattered leucocytes. Glomeruli are congested and capsular spaces occasionally contain red blood cells.

kidney resection. Numerous cases are also reported by Mayo, E. S. Judd, A. Muller, Rumpel, Eisendrath, Legueu, Herick, Lazarus and others. Herick, in 1920, was only able to collect 5 cases of double kidney resection, 2 of them recorded by Rumpel in 1914. These 2 latter cases had a fistula at the time of the report. Buerger, in 1919, recorded a resection of a double kidney which was partially fused to its opposite fellow. Lazarus successfully employed the operation in unilateral, fused kidney. Results have demonstrated the value of this operation in certain localized lesions of calculus or hydronephrosis.

Sacculations of the lower pole are notably more prone to stasis or recurrence of calculi, and persistence of infection. Judd, in quoting Tuffier's work, gives the statement that it is estimated that a man can live with 80-100 gm. of sound kidney tissue. It is said that Czerny was the first to perform partial resection, in the year 1887. This was done for the removal of a

tumor of the lower pole. Papin, in his new book, presents an interesting outline of historical references concerning partial resection operations.

The collected cases during the early years of renal surgery showed very poor results, but it must be stated that even nephrectomy entailed a very high percentage of mortality. Moreover, neoplasm and tuberculosis were being attacked by

partial resections in a number of instances. These matters are now of historic interest only. We are unable to explain the cause of the hematuria in our case, but it would appear to be associated in some way with the increased intrarenal pressure in the hydrocalyx in the upper pole. It would seem as though varying degrees of hydrocalyx might explain certain vague cases of hematuria.

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## CASE REPORTS BY DR. A. RAVICH\*

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### ANGIOFIBROLIPOMA OF KIDNEY

The patient, R. N., is a married woman of forty-three having three children. Her family history is irrelevant, and there is nothing significant about her previous history except for an appendectomy twenty-one years ago for acute appendicitis. During the past three years she had been treated for hypertension, headaches, dizziness and for general aches

and pains.

The patient's urological history began six years ago with a sudden attack of severe pain in the right lower quadrant radiating upward to the right lumbar region and downward along the outer aspect of the right thigh. This attack continued for about an hour and was accompanied by painful urination but no frequency or gross hematuria. The patient was cystoscoped and roentgenographed at that time and though a diagnosis of right renal calculus was made, the patient gives no

history of ever passing the stone. Since this attack she has had more or less constant pain in the right lumbar region radiating downward along the outer aspect of the right thigh. The pain is dull in character, never very severe and is always aggravated during her menses. There was never any pain on the left side. One year previous to examination she began having diurnal frequency every hour and nocturia four times but no dysuria or hematuria. There had been no loss of weight.

Her first examination at the office on April 20, 1928 showed a rather obese, pasty looking woman with slight tenderness in the left lumbar region and over the upper left ureter. The left kidney was distinctly enlarged. She had a myocarditis with a blood pressure of 210/140. The catheterized urine was slightly hazy, acid in reaction with a moderate trace of albumin but no sugar, and showed several red blood cells, several white blood cells, few

\* From the Urological Service of The Jewish Hospital of Brooklyn, N. Y. Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, April 17, 1929.

amorphous phosphates, one hyaline cast, many colon bacilli and micrococcus urea. Roentgen ray showed the right kidney of normal size but

finally agreed to a compromise of cystoscopy without ureteral catheterization and meatoscopy with indigo carmine. Examination thus



FIG. 1. Roentgenogram showing large left kidney and normal size right kidney with scalloped border.

very irregular and scalloped in outline; the left kidney was considerably enlarged with a cyst like shadow overlying it. No calculi were seen in the urinary tract. (Fig. 1.)



FIG. 2. Pyelogram showing typically irregular pelvis diagnostic of renal tumor.

Owing to the very severe reaction following her cystoscopy of six years previous, she at first flatly refused any further examination but



FIG. 3. Gross cross section of tumor showing kidney tissue above, thick capsule, blood clot and large blood spaces, fibrous and fat tissue.

revealed a slight injection of the bladder mucosa with a slight indentation of the posterior wall of the bladder. A tiny cyst was seen on the roof of the bladder, the trigone was slightly elevated and moderately congested, the left ureter orifice was normal but situated behind the normal position, the right ureter orifice was slightly injected and situated anterior to the normal position. Indigo carmine injected intravenously showed an appearance time of five minutes and +4 intensity from the left ureter orifice and eight minutes with +2 intensity from the right ureter orifice. In accordance with the promise to her, ureteral catheterization was not attempted at this time. In spite of this however, on the following day the patient developed a severe attack of left renal colic which required repeated hypodermic injections of morphine for relief. Her condition steadily growing worse, she was admitted to the author's service at the Jewish Hospital of Brooklyn four days later in a stuporous condition with a typical nephritic appearance. Her blood pressure on admission fell to 130/80, the blood chemistry showed

urea nitrogen of only 20 and a total two hour phenolsulphonaphthalein of 40 per cent.

The patient remained in this stuporous,

the prognosis was regarded as quite hopeless. The possibility of death on the operating table was even considered. In order to improve the

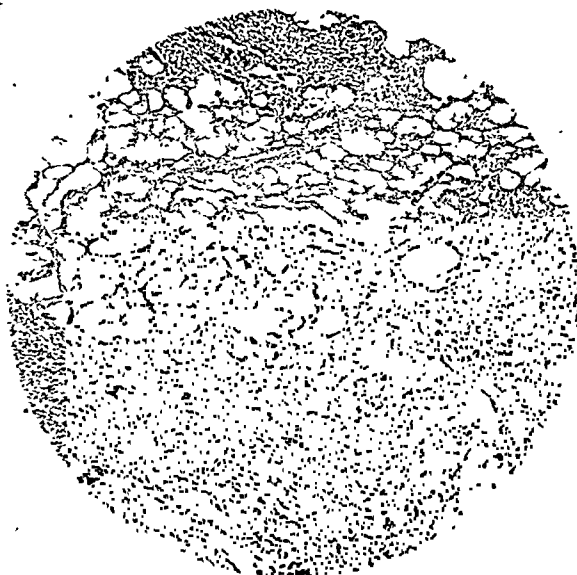


FIG. 4. Low power histological section showing fibrous, fat tissue and vascular spaces.



FIG. 5. High power section showing fat and fibrous tissue.

somnolent state for about ten days, awaking only for short intervals on being aroused. She developed a marked loss of memory and her vision became very poor owing to a hemorrhagic retinitis. During this time her temperature ran up to as high as 104 and she presented definite signs of toxic absorption. Owing to the patient's critical condition, ureteral catheterization was decided upon as a conservative means of relieving if possible any retention of urine in the left kidney. Cystoscopy rapidly done showed a slight injection of the bladder mucosa. A No. 7 F. catheter was easily passed to the left renal pelvis and a few cubic centimeters of highly concentrated, turbid urine was obtained which contained some pus and blood cells with a few colon bacilli. Following this there was a rapid fall in temperature and an improvement in her general condition. A subsequent cystoscopy and pyelographic study performed two weeks later showed a markedly distorted atypical left renal pelvis suggestive of a renal tumor. (Fig. 2.) At this time the author was convinced that he was dealing with a degenerated renal tumor which was causing considerable myocardial as well as general systemic damage by toxic absorption. Her hemoglobin was now reduced to 40 per cent with a red-blood-cell count of 2,300,000. Her condition was progressively getting worse and

condition of the patient sufficiently to withstand operative intervention, a transfusion of 500 c.c. of whole blood was given, and two

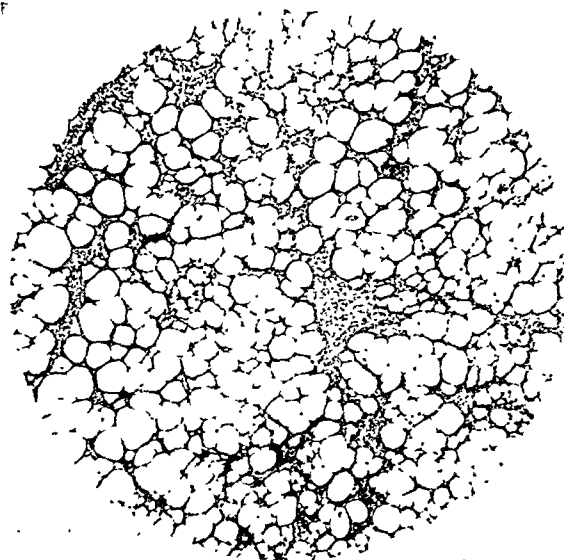


FIG. 6. High power section showing fibrous tissue composed of spindle cells, fat spaces and vascular spaces lined with flat endothelial cells.

days later under spinal anesthesia the operation was performed through a retroperitoneal exposure. A very dense and markedly thickened capsule was freed from numerous adhesions

and a large neoplastic kidney with a very thick pedicle was delivered and removed. The lower pole was found ruptured and numerous organized blood clots were found retroperitoneally below the kidney as well as within the kidney capsule. The patient began to improve immediately following the operation, the temperature quickly dropped to normal and the convalescence was surprisingly smooth and rapid. She was discharged from the hospital twenty days following operation with the wound entirely healed, a normal blood chemistry, blood pressure of 184/118 and a urine which showed just several R.B.C., few W.B.C., few granular casts and few colon bacilli, and a total two hour P.S.P. of 36 per cent.

The pathological report of Dr. M. Lederer reads as follows: Macroscopically the left kidney measures  $18 \times 14 \times 5$  cm. (Fig. 3). Its surface is covered with a plastic exudate. On section the lower half of the organ is occupied by a degenerating blood clot which has an offensive odor. This clot measures about 14 cm. in diameter and lies between the serous layer of the renal capsule and the cortex of the kidney proper. The cortex is very much compressed and forced into the pelvic spaces, obliterating the entire pelvis. The capsule surrounding this portion of the kidney is very thick and can be discerned as consisting of three definite layers. The outer layer is one made up of fibrous bands and fat; the middle layer consists of a greenish-yellow soft gelatinous substance, and the third layer consisting of fat intermingled with a brownish-grey friable tissue difficult of recognition. The blood clot follows the space between the capsule and cortex to the upper pole where again the kidney tissue is compressed into the pelvis. The line of junction between the clot and the kidney tissue is not clear. There appears to be a zone of nodular structure which is arranged in irregular distribution and with the aid of a hand lens it can be seen to invade the cortex of the kidney for a distance of 1 cm. Microscopically (Figs. 4, 5 and 6) the tumor consists mostly of fat cells of irregular size and shape; together with areas of dense fibrous tissue and some variable sized blood spaces. In the body of the tumor mass are many bloody extravasations with destruction of the neoplastic tissue. Many foci, large and small of fat necrosis, with reactive signs are found. The latter consist of round cell infiltrations and

fat containing large giant cells. The fibrous tissue occurs in large and small masses, and is composed of closely packed long spindle cells. The vascular spaces are found in patches, they are large, irregular in shape and lined by flat endothelium. Diagnosis: Angiofibrolipoma of the kidney with hemorrhage.

Since her discharge from the hospital the patient has been practically free from symptoms except for slight precordial distress on exertion and occasional slight right iliac pain. She has gained considerably in weight since the operation. Her blood pressure ranges around 184/115. Her retinitis had cleared up entirely and her general condition is quite satisfactory.

On March 15, 1929 for the relief of pain in the right lumbar region, which had steadily become worse, a cystoscopy was performed and right ureteral catheterization found a hydronephrosis of 12 c.c. of clear urine. Her two hour P.S.P. at this time was 25 per cent, her blood creatinin 1.8, urea nitrogen 12, uric acid 4.6. Her urine was clear, negative sugar, albumin +2, and contained a moderate number of granular casts, few hyaline casts, few W.B.C., few R.B.C., few epithelial cells and moderate number of colon bacilli.

The interesting features presented by this case are:

1. The great rarity of this type of kidney tumor.
2. The relative lack of symptomatology on the pathological left side until after a simple cystoscopy and roentgenography.
3. The pyrexia and toxemia caused by the degenerating tumor.
4. The striking cure following nephrectomy at a time when all hope for recovery had been given up.

### HYPERNEPHROMA IN "PANCAKE TYPE" OF KIDNEY

R. M., a mother of eight children, aged forty-nine years, was first seen on June 14, 1927. Her family history was essentially irrelevant. She had typhus fever as a girl and hemoptysis twelve years ago which she was told was due to heart disease. Three years ago hysterectomy was done for fibroid uterus. One year ago she was confined to bed for twelve weeks with an apparent polyarthritis.



Off and on for several months she had had slight backache. Three days before her first visit at the office the patient was suddenly

vomiting, no chills or fever and no right-sided pain.

Upon examination the patient was found

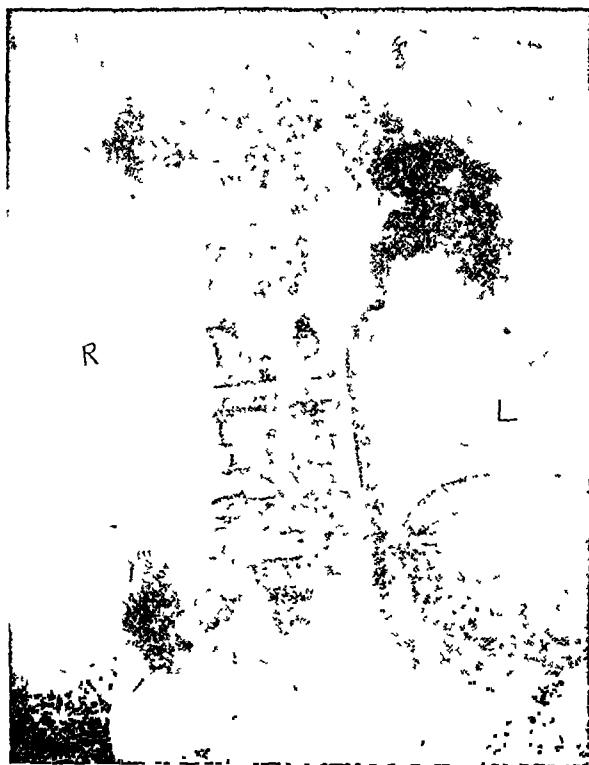


FIG. 1. Left urogram showing typical hydronephrosis with kinking at ureteropelvic junction.

seized with a severe attack of left renal colic which required a hypodermic for relief. The severe pain however persisted and remained

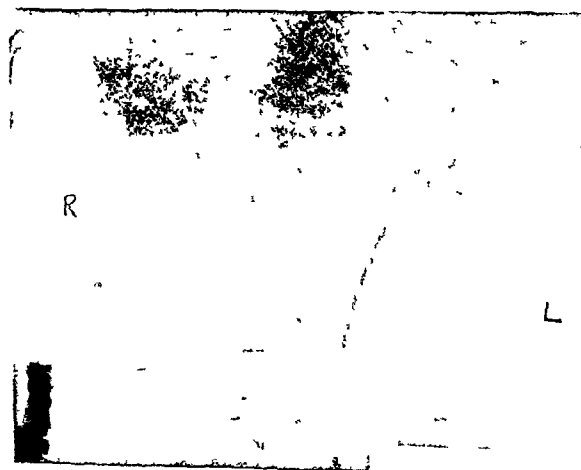


FIG. 2. Left pyelogram taken on same day as Fig. 1.

localized to the left flank and iliac region. Hematuria, frequency, urgency and dysuria were accompanying symptoms. There was no

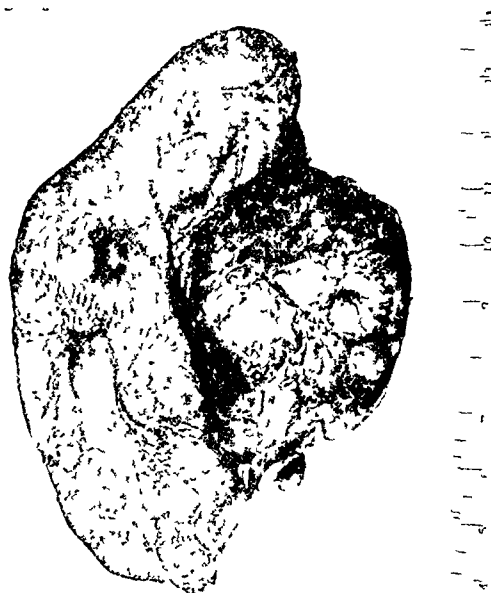


FIG. 3. Gross specimen of tumor with kidney flattened around it

to be in fairly good general condition except for a soft systolic murmur at the apex and a slightly palpable left kidney. Roentgenograms also showed a normal right and a slightly enlarged left kidney. In the left pelvis just below the level of the ischial spine there was a small round shadow in the line of the ureter but having the appearance of a calcified gland. Catheterized urine was very slightly smoky and showed many R.B.C., few W.B.C., and was negative for bacteria and tubercle bacilli. Cystoscopy showed slight injection of the bladder mucosa and a long blood clot lying free on the vesical floor behind the trigone. The right ureter orifice was normal, the left slightly congested and blood stained. Intravenous indigo carmine appeared in normal time and intensity from the right orifice but could not be determined on the left side on account of the blood. A No. 6 F. wax-tipped catheter passed up the left ureter to the renal pelvis found a marked obstruction 24 cm. from the orifice and a hydronephrosis of 30 c.c. of dark bloody urine, the evacuation of which was followed by immediate relief of pain. No scratch was seen on the wax tip. A left pyeloureterogram showed a distended renal pelvis and calyces with definite indentation of the ureter just below the ureteropelvic junction which might be caused by an aberrant vessel

crossing at this point. Below this the ureter was slightly distended down to the ureterovesical junction.



FIG. 4. Histological section showing typical hypernephroma cells.

For seven weeks following this the patient felt so well that she failed to return when she was told. At the end of this period she was again suddenly seized with a severe attack of left renal colic accompanied by hematuria and required several hypodermics of morphine. Cystoscopy at this time revealed several small blood clots in the bladder, normal ureter orifices, and a No. 8 F. catheter passed to the left renal pelvis found a hydronephrosis of 32 c.c. of dark bloody urine. Catheterization of the right ureter found several slight obstructions but no hydronephrosis. Careful search for bacteria and tubercle bacilli again proved negative.

Three weeks later she returned feeling fine and without hematuria. The urine was clear and showed just a few R.B.C. Cystoscopy and catheterization of the left ureter found clear urine and no hydronephrosis. Indigo carmine was equally good on both sides. She felt fine until the end of another month when she first noticed a painless hematuria. At this time though the bladder urine was bloody, only

slightly hazy urine and no hydronephrosis were found on catheterization of the left kidney. The blood again ceased and though

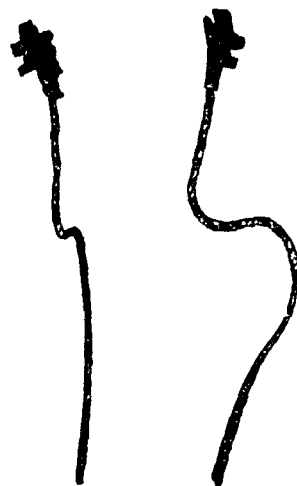


FIG. 5. Diagram of *apparent* kink in ureter as seen on anteroposterior radiograph, corrected by lateral view which shows a gentle curve and no kink.

she continued to feel well the patient returned six weeks later for another ureteral dilatation. At this time catheterization of the left ureter again showed clear urine with no hydronephrosis.

Several days later, on November 9, 1927, the hematuria having recurred, she was admitted to my service at the Jewish Hospital for operation. During the next few days while she was being studied her hematuria again ceased. Laboratory tests revealed a normal blood count, blood urea of 16, creatinin of 1.9 and a total two hour P.S.P. of 54 per cent. The red-blood-cell count was 4,500,000 with hemoglobin of 90 per cent, blood pressure 120/88, Wassermann reaction was negative and bacteriological study of both bladder and kidney specimens showed them again sterile. Cystoscopy performed at this time showed clear and sterile urine from the bladder as well as from both kidneys. Definite obstruction was again found 24 cm. from the bladder and a slight hydronephrosis was noted on the left side. Indigo carmine test again appeared +4 from both sides within the normal time limit. Owing to the finding of a very tiny calculus in the bladder at this time, several pyelograms were made with 20 per cent neosilvol to rule out uric acid calculus. A slightly enlarged movable left kidney with distended pelvis and calyces were found. At the ureteropelvic junction there was evidence of a kink which might have been due to an aberrant vessel.

The opposite kidney was normal. At a later date another urographic study revealed the same findings. A very peculiar phenomenon was noted on several of these films, namely, the extreme mobility of the kidney at different exposures during the same sitting, and an apparent horizontal rotation of the pelvic outline with an overlapping of the lower segment of the pelvis by the upper segment as in an elephant's ear. (Figs. 1 and 2.) Feeling very well and no longer having any hematuria, the patient refused exploratory operation and was discharged from the hospital against advice.

One week later she returned with profuse, painless hematuria and at this time consented to operation. Accordingly, on December 1, under spinal anesthesia, the left kidney was exposed through a lumbar incision and found attached by a long thin pedicle and easily brought out into the wound. A pancake type of kidney with a tumor about the size of a tangerine midway between both poles of the kidney was easily removed. The ureter was found to be small and accompanied by a rather large vein and artery. The extrarenal portion of the pelvis was small. The patient made an uneventful recovery and was discharged fourteen days after admission with primary healing of the wound and in excellent general condition. The urine on discharge was clear and essentially negative, normal blood chemistry and a total two hour P.S.P. of 50 per cent.

Pathological report by Dr. M. Lederer showed grossly a pancake type of kidney considerably thinned out, with its pelvis around a tumor, the size of a tangerine.

(Fig. 3.) The tumor was midway between both poles of the kidney which was otherwise normal in size. Histologically the neoplasm proved to be a typical hypernephroma. (Fig. 4.)

The patient was last seen by the author on August 13, 1928 and found to be in excellent condition with clear urine. A similar favorable report was obtained from her family physician several days ago.

This case is presented because of its many misleading signs, the more important of which are:

1. The striking resemblance of the urogram to a nephroptosis with hydronephrosis caused by an aberrant vessel, and the complete absence of the diagnostic pyelographic outline of kidney tumor.
2. The almost invariable cessation of hematuria following ureteral catheterization.
3. Equally good kidney function on both sides.
4. The comparative rarity of this type and location of hypernephroma.

#### DISCUSSION

DR. LEWALD: I think that without a lateral view of the first case, one could mistake the so-called kink for what would be a gentle curve if one saw it on the lateral aspect. Dr. Ravich called attention to the fact that it was inconstant. I prefer a straight lateral radiograph in a case of this sort. (Fig. 5.) A urologist has demonstrated this experimentally as illustrated.



## NON-OPERATIVE TREATMENT OF TALIPES EQUINOVARUS\*

H. C. MASLAND, M.D.

PHILADELPHIA

THE case of talipes equinovarus here presented is a text upon which to present a plea for a more exact application of the essential mechanical agencies that will correct this as well as other orthopedic deformities by non-operative means. The history is as follows:

A white girl two and a half years old had a lumbar spina bifida and a meningocele, stated on the hospital records to be the size of an orange. She was operated upon the day after birth. The congenital talipes equinovarus was manipulated during infancy but with the attempt to walk the deformity became more pronounced. She was treated in the

\*Submitted for publication June 11, 1929.

orthopedic departments of two of the best hospitals of Philadelphia. A shoe leg brace despite every attempt to adjust it was inefficient as the retracted heel could not be retained in the shoe. The brace turned with the foot upon the leg. The mother was advised that she would have to wait until the child was five years old when an operation would be necessary.

On my first examination, the child stood upon the arch of the foot and the external maleolus. The correction of the deformity demanded that the heel should be under absolute control and rigidly stabilized with the other tarsal bones. Elsewhere<sup>1</sup> I have stressed the virtues of plaster-of-Paris casts, without padding and properly conceived and properly applied to give a control in the reduction of fractures beyond the ability of any other material. The same principles will apply in many orthopedic deformities.

This child's foot was diminutive and plaster bandages, dripping wet, 1 in. wide and 2 yds. long, were applied to form a plaster slipper, leaving the toes bare. The tarsal bones were pliable and the foot was held in normal position except the retracted os calcis. The bandage was applied without tension but moulded around the ball of the heel and tarsal and metatarsal bones, leaving sufficient clearance for the flexing of the ankle joint. It should be applied daintily and moulded quite wet to the varying contours of the foot. When such a cast is properly applied, the plaster being smoothed into the mesh of the bandage, it has a skin surface as smooth as the skin itself.

A small s-shaped hook attached to a string was imbedded in the cast. In Figure 1 it is shown on the outer side of the foot. In a later replacement, I placed it on the dorsum of the foot behind the second phalangeal interspace.

The leg cast was similarly applied to the limb with a hook imbedded in the plaster on the outer side. The cast as first applied would not turn on the leg, with but the subsequent increased activity of the child, it slipped down over the poorly developed calf muscles. It was replaced with a cast extending from the popliteal space to the maleoli. This was retained. After the first cast was applied the child stood for the first time in its life on the sole of its foot and has so continued to do. It will be noticed in the illustration that there

is over correction of the varus deformity. This was produced by placing a small metal strip along the outer side of the sole with the ends



FIG. 1. Elastic traction to overcome shortening of tendo achilles; immediate ability to walk with application of this plaster cast brace.

buried in the cast. I believe that this over-correction is beneficial in walking. The metal strip also prolongs the life of the cast. An elastic band was stretched between the foot and the leg hooks. This should be strong enough to exert a slightly greater continuing tension than the tonal pull of the calf muscles. Great tension might cause the cast to cut the wrinkled skin at the flexure of the ankle joint.

There have been no complications. The child has become an irrepressible walker. After six weeks the tendo Achilles was fully restored to normal length.

The casts should be changed in from six to eight weeks to allow for growth of the parts. Undue wear and other indications might call for a more frequent change. There is not the slightest doubt that the foot can be retained in normal position until the ossification of the bones makes the shape permanent. The recuperation of the damaged muscles and nerves is uncertain. It is quite likely that some form of brace may be required for life. A regula-

<sup>1</sup> Fracture fallacies and some suggestions. *Internat. J. Med. & Surg.*, March, 1929.

tion brace is more durable and less troublesome. It will be applied just as soon as the size of the foot and other conditions insure its efficiency.

It is my conviction that these talipes cases, even congenital dislocations of the hip, can be corrected better than has been done by these graduated but persistent traction methods. Of course this requires an exact comprehension of the mechanical details necessary for success. In meeting these mechanical requirements, I believe that there is nothing that can compare with a plaster-of-paris cast carefully planned and properly applied. It can be laid to escape or include important areas. Applied next the skin, its smooth surface

grips but does not strangulate. Swelling is not a factor here as in fractures where the cast may have to be split and opened some.

The hygroscopic qualities of the cast absorb and dissipate the moisture, thus preserving a dry skin. Fitting snugly, it will not rub and chafe the skin. Where an edge of the plaster might cut the skin, the skin can be protected with an underlying cuff of artificial leather. Proper supervision is to be expected. My plan is to see the patient the day after applying the cast brace, then in a week and then two weeks, always with positive injunctions to return at any time that the slightest occasion for concern might arise.



## SUPPURATIVE MYOSITIS OF THE PSOAS ILIACUS SUGGESTING RENAL PATHOLOGY\*

W. F. MCKENNA, M.D.

BROOKLYN, N. Y.

**P**SOAS abscess is ordinarily considered as of tuberculous origin. In the majority of instances this is undoubtedly true. Whether the case described hereafter was tuberculous in nature has not been absolutely disproved, but the weight of clinical and laboratory evidence was against it. Myositis is well recognized, and suppurative myositis has been frequently observed. Given reported a small series of suppurative psoas myositis cases in 1922, and gave references in the literature to others.

The patient was a woman of thirty-three, married, and the mother of three children. She had always enjoyed good health, and showed no signs of any chronic illness before the present trouble began. Seven weeks before her admission to the hospital she had what she and her family physician described as an attack of grippe from which she made an apparently uneventful recovery. At this time she had a mild fever, and the generalized body pains and

aches so commonly described in this condition. About one week after recovery she had an attack of sharp pain in the right lower quadrant which was thought to be appendicitis, but it disappeared within twenty-four hours, and she again felt perfectly well. About two days after this there was an acute attack of pain in the region of the right kidney. This subsided, but before it had entirely disappeared a similar pain occurred in the left kidney region. This, too, subsided within twenty-four hours, but recurred at the end of three or four days and remained constant for the next four weeks. During this period she had a febrile movement daily to 101° or 102°F. The pain was localized almost exactly over the left costovertebral angle, and was sometimes intense. Her physician said there was always exquisite tenderness at this point. Urinalysis showed large amounts of pus and bacteria, but the specimens were not catheterized.

Seen at her home twenty-four hours before admission the picture presented was certainly suggestive of renal pathology, and a complete urological survey was advised. Except for the

\* Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine April 17, 1929.

very definite localization of the pain, and the temperature, the usual bladder symptoms were lacking. The patient kept the left knee flexed

the region of the kidney with the thought that a perinephritic abscess might be present.

The usual kidney incision was made through



FIG. 1. Haziness of left psoas outline in contrast to very definite outline on right.



FIG. 2. Definite bulging of left psoas outline three days after Figure 1.

at all times and was unable to lie upon the affected side.

The cystoscopic findings after admission were essentially uninformative, as the bladder showed no evidence of disease, and the function of each kidney was normal, and no pus was found in either the bladder or kidney urines. The roentgenograms were of considerable value. As can be seen from the pyelogram plate (Fig. 3) the left kidney is displaced from its usual location, and pushed somewhat upward and to the left. The lumbar spine curves slightly to the right, and a haziness over the region of the left psoas is apparent. At this time both the medical consultant who first saw the case and myself thought that the kidney was not the site of any pathology, but that a retroperitoneal abscess involving the posterior lymphatics or the muscle layers was present. A differential blood cell count showed only 10,200 leucocytes with polymorphonuclear cells of 79 per cent, and as the patient felt somewhat better, and her temperature had receded somewhat the surgical consultant advised against operative measures. The patient was kept under observation for three or four days, but as there was no improvement in her condition, it was decided to explore



FIG. 3. Displacement of left kidney outward and upward. In all three figures slight curvature to right is noticeable.

the skin and fascial layers. Upon approaching the muscle layer the external oblique and internal oblique were incised at their thinned-

out portions, and pus was found. There was still a thickened layer of swollen and congested fascia which was not incised, and the kidney could not be palpated beneath it. This layer was felt to be the transversalis fascia, much distorted by the inflammatory process extending from the deeper part of the abscess. If such were the case the suppurative process had extended by continuity from the psoas sheath along the sheath of the quadratus to the transversalis.

The cultures from the pus were *Staphylococcus aureus*.

The patient made a smooth convalescence, and was discharged from the hospital about two weeks after operation with a small draining area.

The patient can walk easily, has no pain, and can use the left leg as well as the right.

The principal interest in this case lies in the somewhat rare underlying pathology, the suggestion of either a renal or perirenal lesion, and the unusual site in which the abscess was apparently pointing. There was no sign of pointing in the groin or loin, and no mass or point of tenderness existed except at the costo-vertebral angle.

In the cases so well described by Given the abscess gave signs of pointing in the groin, and these cases as described by him were opened in the lower abdomen, and drained through an extraperitoneal incision. There was no evidence of any lesion of the vertebral column noted except the slight curvature to the right which was probably due to spasm of the erector group.



## URIC ACID CALCULI\*

FEDOR L. SENGER, M.D.

BROOKLYN, N. Y.

THE literature on the less dense urinary calculi is rather meager, there being very little written beyond an analysis of the stones and statements of their percentage of incidence. Recently we have had on Dr. Read's service three cases over a period of four months, rather a large number even in a fairly active urologic service.

Swain in 1897<sup>1</sup> made the observation that urinary stones of varying chemical compositions had a marked difference in penetrability to the roentgen ray. He placed calculi directly on the roentgen-ray plates and exposed them from one to sixteen minutes. He observed that the more dense the stone, the deeper the resultant shadow. He tabulated his results as follows, according to density of shadow. Stones composed of:

1. Calcium oxalate.
2. Calcium phosphate.
3. Uric acid.

<sup>1</sup> *Bristol M. J.*

\* Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, April 17, 1929.

Cystin xanthin and cholesterin are also less dense than bone (ribs).

He also made the interesting observation that the longer the exposure to the rays the less dense the resultant shadow, so that at the extreme limit of sixteen minutes' exposure only the calcium oxalate stones cast shadows on the negative. He definitely drew the conclusions that for accuracy in diagnosis short sharp exposures were the best, which even today with our improved technic is still true.

Some cases have been reported in which these less dense stones show areas in pyelograms of greater transparency than the opaque media 12 per cent iodide, giving the suggestion of a non-opaque stone.

A report of my cases follows:

CASE 1. Adult male, aged fifty years, admitted September 24, 1928. His admission diagnosis was tumor of the kidney, due to the presence of a large palpable mass in the left kidney region.

His previous history is entirely irrelevant except that he had noticed the mass in his side for about six or seven months. He had never had any urinary symptoms except some night frequency, and never any colicky pains. His urinary examination showed some microscopic blood and pus cells, but otherwise clear urine.

Cystoscopy: Catheters passed to the left and right kidney pelvis easily, but no urine was recovered from the left side at all, the right side gave us normal urine and normal function.

The left pyelogram shows a definite arresting of the solution at the pelvic ureteral junction with just a suspicion of a little of the media trickling up to the pelvis. We repeated this at several sittings with the same result in each instance. Accordingly we made a diagnosis of renal tumor, with filling of the pelvis and advised operation.

At the time of operation we were greatly surprised to find a large pyonephrotic kidney with a stone blocking the ureter completely and the kidney full of pus and small stones and debris, none of which show in our plates. We took the specimen to our roentgenologist who placed it directly on a plate and took several exposures of different durations and even this failed to show these calculi very definitely.

Mr. Steel of the department of chemistry analysed these stones and reported them to be pure uric acid plus some fats and other organic matter. Another quite remarkable feature is the entire absence of pain during the blocking and destruction of this kidney.

CASE II. Adult male, aged sixty-one, with prostatic obstruction.

During a routine cystoscopy we found three smooth yellow stones lying in the base of the bladder. These looked like ammonium urate stones, and with our previous case in mind we decided to roentgenograph them. The resultant picture does not show any stones.

We then did a cystogram with iodide. Still no stones. But the air cystogram showed them up beautifully.

The chemical analysis of these stones showed ammonium urate around a nucleus of uric acid.

This air cystogram suggests to me the possibility of doing air pyelograms for diagnosis in uric acid stones of the kidney pelvis.

CASE III. Mrs. J. S., aged forty-six, admitted November 30, 1928, complaining

of painful urination, with frequency and cloudy urine. Her history dates back over a period of years, with an indefinite sense of something wrong in her left side.

The bladder urine was full of blood and pus cells.

Cystoscopy: Both ureters easily catheterized, the right side being clear and normal, as regards function and urea. On the left side the urine was pusy. The appearance time of the phthalein delayed for nine minutes, and urea lower than normal.

On checking up the pyelogram we noticed that in the kidney pelvis there was an area less dense than the media encircling it and concluded that we had a uric acid stone in addition to pyonephrosis.

At operation this stone was removed by pyelotomy and on analysis proved to be uric acid.

Before this patient left the hospital we dilated her ureter and collected urine from this side. This urine contains a large number of uric acid crystals.

We did the same thing on the bladder urine from the previous case, letting it sediment, and found that it also contained large quantities of uric acid crystals, in all the characteristic shapes, with stones in sheaves and rosettes.

We are trying to keep the urines in these cases neutral or slightly alkaline in the hopes of avoiding future trouble.

#### DISCUSSION

DR. L. T. LEWALD: The question of uric acid calculi constantly comes up in roentgenological work. The combination in the last case of the three stones in the bladder together with the sodium iodide, plus air, offered a contrast such as we now get in tetraiodide examination of the gall bladder. It was the coating with sodium iodide that helped to make the very beautiful demonstration.

DR. A. RAVICH: During the past few years I have found urography with 20 per cent neosilvol of much value in outlining uric acid calculi in the renal pelvis and ureter. I have a number of films which show these stones beautifully. These would otherwise be overlooked if sodium iodide were used as a pyelographic medium.

DR. SENGER: We have tried Dr. Ravich's method with neosilvol, using varying percentages of solution, but have not been able to outline anything satisfactorily with this.



# DEPARTMENT OF RADIOLOGY

JAMES T. CASE, M.D., F.A.C.S., EDITOR

## CLINIC ON MALIGNANT DISEASES MEMORIAL HOSPITAL, NEW YORK

PRESENTED BY THE STAFF OF THE MEMORIAL HOSPITAL, SEPTEMBER, 19, 1929

### INTRODUCTION

DOUGLAS QUICK, Chairman

IN the two hours at our disposal we shall attempt to give you a comprehensive insight into the routine work of our institution. Our work is limited to the study and treatment of cancer and allied diseases, so that we shall deal with therapy rather than diagnosis. Each of our clinical departments, except that one which we choose to term the department of medical malignant diseases, is under the direction of a surgeon who is completely responsible for the treatment of the case throughout, whether that treatment be surgical or radiological. We regard the treatment of cancer as being essentially a surgical problem. We believe that the best interests of the patient are served by having the entire treatment of that patient under one directing head, with adequate interdepartmental consultation, of course. Our clinical organization consists of a number of departments, each under the direction of an attending surgeon trained not only in his surgical specialty but radiologically as well. The departments are all correlated by a clinical director.

In arranging our program for this clinic we have attempted to select topics which, we hope, will give as wide a range of problems as possible and our methods of dealing with them.

### GIANT-CELL TUMORS OF BONE

WITH SPECIAL REFERENCE TO TREATMENT  
TECHNIC

R. E. HERENDEEN, Roentgenologist

CASE I. *Giant cell tumor of the radius.*  
A. F., male, aged eleven, admitted October 8, 1927.

*History* of two injuries to the left wrist in the past ten months, followed by pain and swelling. Treatment was by massage and splints, and following a biopsy, by incision, chemical and thermal cautery, and bone graft.

*Examination* showed a hard bony tumor in the left forearm, expanding the bone and causing a swelling about three times the size of the normal bone. X-ray films confirmed the findings of an active recurrence with absorption of the bone graft.

*Microscopic examination* (of specimen from former operation) showed a giant cell tumor of cellular but benign type.

*Treatment* consisted of high voltage x-rays, and succeeding films demonstrate the satisfactory response, and the patient's present condition.

CASE II. *Giant cell tumor of the os calcis.*  
E. C., aged five, admitted November 6, 1924.

*History* of sudden onset of pain in the foot two and one-half years ago. The pain and swelling have grown worse in spite of various treatments, including immobilization brace and splints. At present the greatest circumference of the left ankle is 30 cm., as compared to 21 cm. of the right ankle.

*Treatment* was by low and medium voltage x-rays over a period of four months.

Succeeding films demonstrate the condition of the os calcis at the first visit here, and the improvement subsequent to x-ray therapy.

### CASE III. *Giant cell sarcoma of the right humerus.*

A. U., female aged sixty-five, admitted October 24, 1924.

*History* of "fever" and pain in the right shoulder and elbow of six months' duration, with limitation of motion.

*Examination* by x-ray films demonstrated a destructive process in the distal end of the humerus.

*Treatment* by x-ray therapy was followed by subsidence of the swelling and disappearance of pain. The roentgenograms demonstrate the amount of repair.

About two years later a similar process developed in the ascending ramus of the right inferior maxilla, and since that time, during the past three years, at irregular intervals, similar tumors have appeared, some bone and some in the soft parts in various areas widely scattered over the entire body. Response to radiation is always the same as was obtained in the treatment of the primary tumor.

The patient's general condition has improved and has been excellent during the past five years, excepting for short periods during the development of new tumors.

## TYPES AND TREATMENT OF BONE SARCOMA

WILLIAM B. COLEY, Attending Surgeon

Two definite types of bone sarcoma are included in the cases presented: the osteogenic and the endothelial myeloma (Ewing's sarcoma). The osteogenic type associated with considerable new bone formation has been found both extremely radioresistant and also rarely curable by amputation. Amputation followed by prophylactic treatment with the mixed toxins of erysipelas and *Bacillus prodigiosus* has, in the speaker's hands, given far better results. This method was employed in Case v as well as in a series of 40 cases of osteogenic sarcoma including the endothelioma type, but excluding the giant-cell,

in which a study of the end-results showed 50 per cent of the patients to be alive from five to twenty-five years.

Cases IV and VI, here presented, show what can be accomplished by a combination of toxins and radiation in far-advanced and inoperable stages of the disease. In both cases, generalization had taken place, and the x-ray plates showed evidence of pulmonary metastasis in both. Case IV indicates that the endotheliomatous type of bone sarcoma should rarely be considered entirely hopeless.

At the Memorial Hospital during the past twelve years, practically all cases of primary operable sarcoma of the long bones, of all varieties, have been treated by radiation as the method of choice. The reason for this lies in the fact that the Memorial Hospital is fundamentally a research institution, and it was believed important to determine what can be accomplished by radiation in these cases. An analysis of the end-results in 1928 showed that of 92 cases of primary operable sarcoma of the long bones (exclusive of giant-cell tumors) in which radiation had been employed as the primary method of choice, 45 had developed metastases while undergoing treatment, and in most cases while the local condition was showing more or less evidence of improvement; all of these had died. In 45 cases, amputation was performed after varying periods (two months or more) of irradiation. It was thought by some of the members of the staff that even in cases of failure to control the disease, preliminary radiation before amputation might yield better final results. In the group so treated, only 3 were known to be well for five years. In other words, this method does not yield so good results as does early amputation alone. At the International Cancer Conference in London, July 1928, Dr. Ewing stated that early amputation is the best method of treating osteogenic sarcoma of the long bones; to this, I would supplement a prolonged course of prophylactic toxin treatment.

In the endothelioma type of bone sarcoma, which has been found to be highly sensitive to both radiation and toxins, attempt to save the limb should be made in practically all cases. In those in which amputation has to be employed, a prolonged course of prophylactic toxin treatment should be given. In osteogenic sarcoma of the long bones with marked new bone formation, early amputation without preliminary radiation is, at present, the method of treatment at the Memorial Hospital.

**Giant Cell Tumors.** Although the Memorial Hospital is the first institution to demonstrate the possibility of curing cases of giant-cell bone tumor by radiation alone, and in spite of the fact that Dr. Herendeen can show some very remarkable results in treating this type of tumor of the long bones by radiation, there is still a doubt that this is the method of choice, first, because of the longer period of disability entailed, and second, the difficulty of making a correct differential diagnosis between benign giant-cell tumor of the long bones and malignant tumor. At the Memorial Hospital it has been found impossible to make a correct diagnosis in 1 out of 4 cases: in many cases of supposed benign giant-cell sarcoma treated by radiation without biopsy, it has been revealed later that the condition was really malignant and that metastases had developed before the true nature of the tumor had been recognized, with the result that the chance of saving the patient's life by amputation had been lost.

Bloodgood has shown that a very large proportion of giant-cell tumors may be cured by curettage, although in a certain number of cases, especially those with disease involving the lower end of the femur, amputation may finally have to be performed. In my opinion the present method of choice in the treatment of giant-cell sarcoma of the long bones is a very extensive curettage, swabbing out the cavity with zinc chloride or pure carbolic acid, followed by a two or three month

period of toxin treatment. A number of my most brilliant results have been obtained with the toxins alone, without curettage.

The question, however, as to the best method of treatment of giant-cell sarcoma is still unanswered; further study of a much greater amount of material is required before any hard and fast rules can be laid down.

**CASE IV.** *Periosteal sarcoma (endothelioma type) of fibula with metastases to groin, abdomen, and possibly, lungs.*

H. S., male, aged eight, first seen in consultation, June 1920, admitted, October, 1920.

*History of injury to leg* January 1920, after which pain and swelling, apparently of bony origin, developed. Clinical and roentgenographic diagnosis was osteomyelitis. In March, 1920, an exploratory operation revealed some pus and marked thickening of the bone, which was extensively curetted. Microscopic examination showed the disease to be periosteal sarcoma of the endothelioma type. After operation, the tumor grew with great rapidity.

*Examination in consultation* showed the lower two-thirds of the fibula occupied by a large tumor, apparently of periosteal origin, fungating in the central portion. The glands in the groin were enlarged, one to the size of an English walnut.

*Treatment* consisted in immediate amputation followed by toxins.

*Pathological report* by Dr. F. M. Jeffries was round-cell sarcoma of periosteal origin; by Dr. Ewing, endothelioma.

Toxins were given daily to the point of producing a marked reaction, after which injections were given only every other day; the glands in the groin decreased somewhat in size but did not disappear. In July 1920, a gland was removed and the microscopic examination showed round-cell sarcoma. The toxin treatment was kept up until the middle of August. Re-examination in October 1920, showed the inguinal glands increased in size, and a hard mass, the size of a child's head, in the right iliac fossa, evidently involving the retroperitoneal glands. A roentgenogram of the chest showed well-developed unquestionable metastasis to the lung.

*Treatment at Memorial Hospital*, where the child was admitted in October 1920, consisted in 10,109 mc.-hrs. of radium at 7 cm. distance.

The child was then taken home as a hopeless prognosis had been given. There were no further toxins or radium treatments. In May 1921, a letter was received stating that the patient was apparently in excellent health and going to school regularly. He returned to the Memorial Hospital in September 1922, and a careful examination failed to reveal any evidence of tumor in the abdomen or the groin, and a roentgenogram of the chest failed to show any evidence of pulmonary metastasis. The patient has remained well up to the present time, nine years later.

This is case No. 267 in the Bone Sarcoma Registry. The diagnosis of that committee was Ewing's tumor.

**CASE V.** *Extensive periosteal osteogenic sarcoma of the lower end of the femur. Amputation and prolonged toxin treatment.*

S. D., female, aged eighteen, admitted to the Hospital for Ruptured and Crippled, March 1906.

*History* of pain in the right knee early in 1905; in August a plaster splint was applied and worn for nearly seven months, during which time the patient had become emaciated and bed-ridden.

*Examination* showed a fusiform swelling of the right knee just above the joint, with a circumference 5 inches greater than that of the opposite side. Roentgen-ray examination showed the lower 6 inches of the femur nearly twice the normal thickness.

*Treatment* began with an exploratory operation (Drs. Gibney and Coley) which revealed what was believed to be a sarcoma, and was followed by immediate amputation. The patient was then put upon the mixed toxins, with injections increased to the point of producing marked reactions. Almost immediate improvement followed, with increase of the patient's weight from 69 lb. on June 2, to 92 lb. on October 28. She has remained well up to the present time, over twenty-two years.

In this case, the diagnosis made by Dr. Jeffries, pathologist of the Hospital for Ruptured and Crippled, was osteosarcoma, mixed cell (no giant cells). Dr. Ewing examined a section sometime later, and made a diagnosis of malignant osteogenic sarcoma. This is the diagnosis that was made by the Bone Sarcoma Registry (Case No. 408).

**CASE VI.** *Sarcoma (angioendothelioma type) of the tibia and fibula with multiple metastases to the lungs.*

C. P., male, aged twenty-eight, admitted August 1924.

*History* of pain in the upper end of the left fibula, July 1923. One month later a smooth mass, the size of a lemon, was found at the same site, and shortly after, a distinct bruit was heard on auscultation. A diagnosis of aneurysm of the popliteal artery was made, and the tumor was removed, September 1923. Roentgen-ray treatment was begun at once. In August 1924, the patient complained of severe pain and weakness in the upper end of the fibula, and at the same time, a swelling was noticed in the lower end of the tibia.

*Examination* at the Memorial Hospital showed the upper end of the left fibula to be the site of a globular, pulsating, tense tumor, measuring 5 cm. in diameter. Over the anterior portion of the left tibia, at the junction of the middle and lower thirds, a large swelling measured  $8 \times 5$  cm. A roentgenogram of the tibia showed a central tumor, practically destroying the tibia for a distance of 3 or 4 inches. A roentgenogram of the chest showed distinct evidence of metastasis to the lungs. The clinical diagnosis was recurrent sarcoma of the fibula, with metastases to the tibia and the lungs.

*Treatment* between August 20, 1924 and December 20, 1925, consisted of twenty-five high-voltage roentgen-ray exposures, each of eighty minutes' duration; fourteen were given over the chest, and eleven over the tibia and fibula. The disease was kept under fair control until the summer of 1925 when the tumors of the tibia and of the lung showed evidence of increase in size. The patient was re-admitted and toxin treatment begun; in September 1925, examination showed some regression of the tumors, a gain in weight, and improvement in the general condition. Toxin treatment was resumed, February 1926. Frequent roentgenograms showed no increase in size of the metastatic tumor of the lung.

The pathological fracture, however, had never shown any tendency to union, the leg was kept in a splint and was entirely useless, so amputation was performed by Dr. Bradley L. Coley in June 1926.

*Pathological report* by Dr. Ewing was angioendothelioma, very bizarre structure. Dr. Ewing's previous diagnosis on the specimen removed from the soft parts of the calf was angioendothelioma of bone or metastatic renal carcinoma.

Since amputation, the patient has remained in good condition. Another course of toxin treatment has been given. There is no evidence of increase in size of the tumor of the lung.

This case is remarkable, first, because of the long period during which the extensive metastases of the lungs have been kept under sufficient control (first by roentgen rays alone, and later by roentgen rays and toxins); and, second, because of the very large amount of roentgen rays that were used without apparent harm.

This is case No. 574 in the Bone Sarcoma Registry. The diagnosis of that committee was metastatic hypernephroma.

## THE MALIGNANT GRANULOMAS

LLOYD F. CRAVER, Attending Physician

Out of the vast collection of diverse clinical pictures embraced in the term malignant granulomas, 2 cases illustrating involvement of tissues in or about the mediastinum are selected for presentation. One is a case of probable Hodgkin's disease of the hilal lymph nodes; the other, Hodgkin's disease of the thymus.

These cases illustrate the fact that occasionally Hodgkin's disease begins or, at least, first manifests itself in or about the mediastinum, and may remain for a considerable time fairly well localized to that region. The same is true of lymphosarcoma.

Of the tumors of the thymus (thymomas), by far the most frequent type is that which is very radiosensitive, thymic lymphosarcoma. Yet, occasionally a tumor presenting all the clinical and roentgenographic features of thymoma proves to be radio-resistant. Several of these, at autopsy, have been found to be thymic carcinoma.

It has seemed possible to foretell the radioresistance of some of these tumors on a clinical basis. Patients with such radio-resistant growths are likely to present a striking network of dark veins on the chest wall, an evidence of more marked venous stasis than appears in most of the thymomas; also, if the supraclavicular or axillary nodes are involved, they are stony hard. Such cases usually have considerable stridor.

On the other hand, those cases of thymoma which have shown penetration of the chest wall and production of sternal or parasternal tumors have, as a rule, been found to belong in the class of very radio-sensitive tumors. An exception is noted in the second case reported, a thymic Hodgkin's disease only moderately responsive to repeated heavy radiation.

Satisfactory treatment of these deeply situated intrathoracic tumors requires radiation of a penetrating type, such as is furnished by the high-voltage x-ray machines at 175 to 185 k.v. with 0.5 mm. Cu filter at a distance of 50 cm., or the radon or radium element pack filtered through the equivalent of 2 mm. brass at a distance of 10 to 15 cm. The dosage must depend upon several considerations, not the least of which is the patient's general condition. Best results are obtained by attempting to secure long palliation. Overdosage in an attempt to cure may either damage the skin so as to prevent necessary subsequent treatment, or may depress the patient's general condition to such an extent that the desired palliation is defeated.

### CASE VII. *Mediastinal tumor.*

S. R., male, aged sixteen, admitted April 1928.

*History* of frequent epistaxis for many years, with recent more acute onset of hemoptysis, apparently following gripe.

*Examination* by x-ray films showed hilal masses. Diagnosis questionable; probably Hodgkin's disease of the hilal nodes.

*Treatment* began April 1928 with an exposure of 300 ma. min., 1.5 mm. Cu, 175 k.v., 50 cm. target-skin distance over each hilus anteriorly. The response was unsatisfactory. In June 1928, an exposure with the same factors was given to each hilus anteriorly and posteriorly, a total of four exposures. In September 1928, by the radon pack, 20,000 mc.-hrs. at 10 cm. distance were given the mediastinum anteriorly.

The results have been a gradual reduction in the hilal masses. The patient is in excellent general condition, has gained weight, feels well, and has been swimming all summer.

CASE VIII. *Mediastinal tumor.*

P. V., male, aged nineteen, admitted March 1928.

*History* of pain in the left arm, fourteen months previously; tonsillectomy was performed for a supposed neuritis, with a partial relief of pain. Shortly after, a swelling appeared over the sternum; this was treated by x-radiation, elsewhere, for three months without regression.

*Examination* showed bulky masses in the mediastinum, the chest wall, and in both cervical regions with moderate enlargement of the axillary nodes. Otherwise, the patient was comparatively symptom-free.

*Pathological report* on a supraclavicular node was thymic tumor, granulomatous, of large cell type.

*Treatment* from March to July 1928, consisted of 20,000 mc.-hrs. at 10 cm. distance, to each side of the neck by the radon pack, and of 40,000 mc.-hrs. at 15 cm. distance to the mediastinum anteriorly, a total of thirteen exposures. Also, from June 1928 to September 3, 1929, twenty-seven exposures have been given of high-voltage x-radiation, mostly at 50 cm. target-skin distance, some at 30 cm. distance, 185 or 175 k.v., 0.5 mm. Cu, and 140 to 360 ma.-min., depending upon the distance factor, to the mediastinum anteriorly and posteriorly, to the neck, and the chest wall masses.

## NEOPLASMS OF THE VULVA

WILLIAM P. HEALY, Attending Gynecologist

In the 3 cases reported herewith, 2 of carcinoma and 1 of epithelial papilloma, it is of interest to note that in each instance the neoplasm developed on a pre-existing skin lesion. All the cases gave a history of pruritus vulvae and all had leucoderma with marked thickening of the skin of the vulva.

Practically all cases of epithelioma of the vulva are histologically of the adult, fully developed squamous variety of cancer cell and, therefore, are relatively radioreistant. For this reason a heavy or caustic dose of ray therapy must be applied in order to cause the disappearance of the lesion. As the inguinal glands in practically all instances are involved on one or

both sides, both groins should also be heavily irradiated. When the reaction from this treatment has subsided, we are in

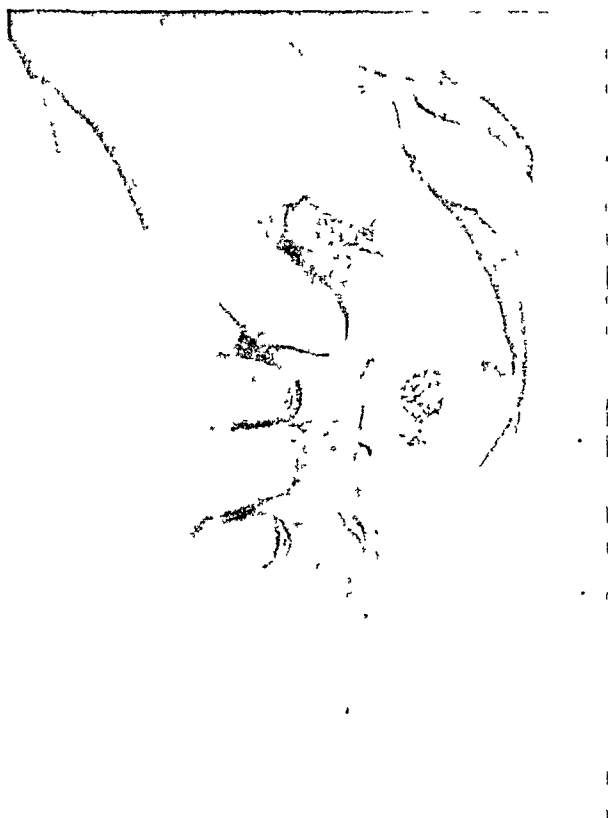


FIG. 1. Case VIII. N. W., #35796. Papillary ulcer 3.5 cm. in diameter. Smaller ulcer 0.5 cm. in diameter below large one. Well marked leucoderma.

favor of vulvectomy with dissection of one or both groins. We feel that this combination of heavy radiation followed by radical operation offers the patient the best chance of cure.

CASE VIII. *Primary carcinoma of the vulva.*

N. W., #35796, married, nullipara, aged fifty, admitted February 21, 1926.

*History* of gradually enlarging sore on the vulva of two months' duration, without pain or treatment.

*Examination* showed a papillary ulcer, 3.5 cm. in diameter, on the upper portion of the left side of the vulva with a smaller lesion, 0.5 cm. in diameter, growing below it, together with a well-marked leucoderma of the vulva. The left groin contained a mass of fixed glands, 2.5 cm. in diameter; the right groin was negative.

*Pathological report* was squamous carcinoma, grade 1.

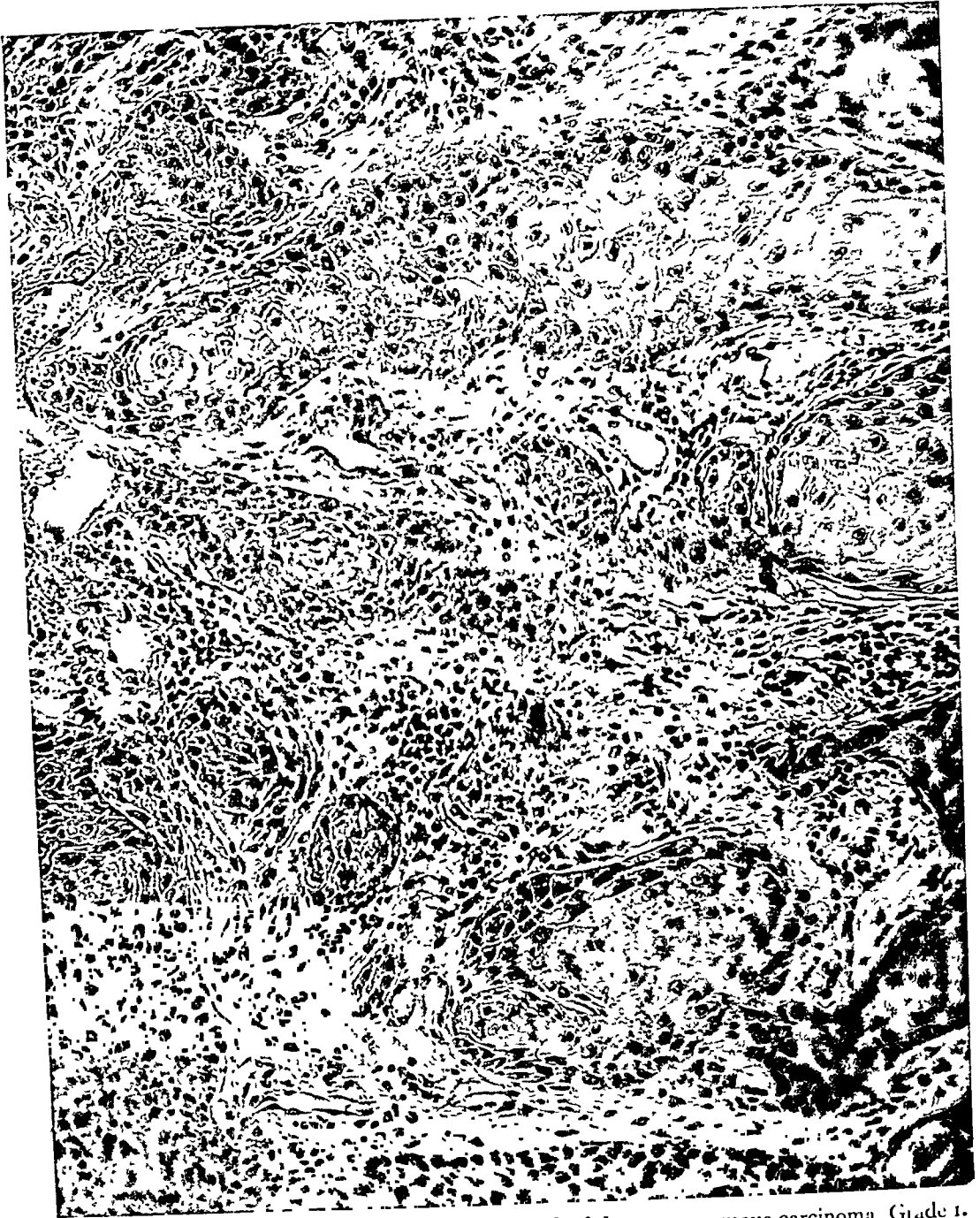


FIG. 2. Case VIII. N. W. #35796. Fully developed adult type squamous carcinoma, Grade 1.

Treatment began February 23 with an overdosage of radium: 6 gold seeds, each 2.31 mc., 0.3 mm. gold filtration, were buried

Treatment began March 30, with the insertion of 7 gold seeds, a total of 11.03 mc., with a total dosage of 1471 mc.-hrs. On April 5 and



FIG. 3. Case ix. J. G., #35923. Recurrent lesion on admission, March, 1926.

in the large ulcer, a total dosage of 1848 mc.-hrs., one gold seed, 2.31 mc., was placed in the small ulcer, a total of 308 mc.-hrs., three gold seeds, each 2.19 mc., were buried in the mass in the left groin, a total dosage of 876 mc.-hrs.

Treatment caused considerable local reaction with edema of the vulva and fluctuation in the gland mass during the ensuing six weeks. At the end of two months there had been excellent regression of the primary lesion and fibrosis of the glands in the left groin.

On June 1, complete vulvectomy with dissection of both groins was carried out.

#### CASE IX. *Recurrent carcinoma of the vulva.*

J. G., #35923, married, nullipara, aged forty-five, admitted March 29, 1926.

History of a small, white, painful nodule which appeared on the vulva two years ago and was excised three months later. The lesion recurred in three months and was again excised, August 1925; in November 1925, another quite painful recurrence appeared.

Examination showed a well marked leucoderma of the vulva. The left labium minus had been excised. To the left of the clitoris there was an ulcerated, elevated lesion, 2.5 X 3 cm. in diameter. One hard gland could be felt in each groin.

Pathological report was infiltrating squamous carcinoma, grade II, radioresistant.



FIG. 5. Case x. M. G. H., #38235. Bulky papillary tumor. Superficial ulceration in various places. No infiltration at base. Lesion 4 X 8 X 4 cm.

6, x-radiation was applied to each groin, respectively, 240 ma.-min., 0.5 mm. copper filtration.

There was excellent regression from treatment, but an extensive attack of psoriasis developed, particularly in the lower abdomen.

On June 16, 1926, 2 gold seeds, 3.74 mc., were inserted in the top of the lesion of the left labium, a total dosage of 496 mc.-hrs. Over a year later, July 7, 1927, it was noted that the local lesion was not improving, and on July 23, vulvectomy with dissections of both groins was performed. Up to the present, September, 1929, there is no evidence of recurrence.

#### CASE X. *Epithelial papilloma of the vulva.*

M. G. H., #38235, single, aged seventy-four, admitted January 7, 1928.

History of a small lump which appeared on the right side of the vulva eleven months previously and gradually increased in size. Pruritus vulvae had been present for ten years; the urine was negative for sugar.





FIG. 4. Case ix. J. G. #35923. Slide from St. Francis' Hospital, from operation on primary growth, August, 1925. Diagnosed by Dr. Ewing as infiltrating squamous carcinoma, grade II+, radioresistant.



FIG. 6. Case x. M. G. H., #38235. Typical epithelial papilloma. Extensive perivascular plasma-cell infiltration.  
No definite evidence of carcinoma.

*Examination* showed the right side of the vulva covered by a bulky, papillary growth,  $4 \times 8 \times 4$  cm., slightly ulcerated in places. The tumor did not seem to infiltrate the base. No glands were palpable in the groins.

*Diagnosis* was epithelial papilloma of the vulva.

*Treatment* consisted in excision of the tumor mass, January 10, 1928. No radiation was given.

*Pathological report* was epithelial papilloma; the under border is irregular but shows no definite infiltration; there is an extensive perivascular plasma cell infiltration.

## MALIGNANT GROWTHS OF THE EXTERNAL GENITALIA

BENJAMIN S. BARRINGER, Attending Urologist

The control of carcinoma of the bladder at the Memorial Hospital for the past fifteen years has been by means of radium implantation into the growth. No matter how accessible the growth for operative removal, this latter has never been attempted.

In a large majority of cases, implantation is made under vision through the open bladder. The technic consists in opening the bladder under spinal anesthesia, cauterizing off any pedunculated parts of the tumor, and implanting the base with gold seeds, using one seed of 2 mc. to each square centimeter of base. The operative mortality of radium implantation through a cystotomy wound in more than 150 consecutive personal cases has been between 3 and 4 per cent.

With this method of treatment, we have been able to cure cases which were beyond operation, and the percentage of control in both papillary and infiltrated carcinoma is better than that shown by operative statistics.

Prostatic carcinoma has been treated as follows: Intensive deep x-ray therapy from five portals of entry is given to the prostate; in addition, in those cases in which the growth is reasonably small and confined to the prostatic and periprostatic regions, gold seeds are implanted through

the perineum into the carcinoma. These procedures have no effect upon reducing the residual urine, if any be present, but as a rule, they prevent its increase. The problem of residual urine is dealt with by a minor operation by punching out the obstructing portion of the prostate through the urethra.

### CASE XI. *Carcinoma of the bladder.*

J. B. H., female, married, aged fifty-three, admitted March 1922.

*History* of frequent and painful urination of one year's duration, without hematuria.

*Examination* by cystoscopy revealed on the left side of the bladder vault, running from one to five o'clock, a papillary tumor 3.5 sq. cm. in size, with a surface slough. The growth extended within half a centimeter of the left ureteral orifice.

*Pathological report* was papillary carcinoma with atypical, hyperchromatic cells.

*Treatment* consisted of two implantations of glass seeds through the cystoscope, first, with four seeds of 1.08 mc. each in the base, and the second time, with five seeds of 1 mc. each in the base.

The patient has remained well to date, over a period of seven years, and cystoscopically no tumor is present. She has had during the past year a slight leucoplakia at the site of the old tumor, proved by pathological examination.

### CASE XII. *Carcinoma of the prostate.*

T. A. S., #39380, aged sixty-seven, admitted November 1928.

*History* of prostatectomy, three months previously, with a microscopic report of carcinoma.

*Examination* rectally showed a small, rather irregular and somewhat lumpy prostate bed, and a diagnosis was made of recurrent carcinoma of the sheath of the prostate.

*Treatment* by insertion of radium needles in the prostate was given twice. On November 13, 1928, two needles of 150 mc. each, screened by steel in each side of the prostate, remained in situ for two hours and were then removed. This treatment was repeated January 24, 1929, with two needles of 44 mc. each for three hours.

Today the patient's prostate and periprostatic region feel absolutely soft, and there is no residual urine.

## RECTAL CANCER:

PRINCIPLES AND METHODS OF TREATMENT  
AT THE MEMORIAL HOSPITALGEORGE E. BINKLEY, Associate Attending  
Surgeon

A routine method of treatment is not employed, due to the fact that several varying factors must be taken into consideration, namely, the condition of the patient, the stage of the disease, the location of the tumor, the degree of malignancy of the mass, and the degree of radiosensitivity of the cancer cells. Consequently, cases are classified and treated in accordance with the above clinical and pathological conditions.

Radiation therapy forms the basis of treatment, but colostomy and radical surgical excision are supplemented in all cases in which surgical interference offers an additional advantage. The various types of radiation therapy now employed consist of external applications of radium and high-voltage roentgen-rays and interstitial applications of gold filtered emanation seeds. The additional 4 gm. element pack for external applications, and the increased filter of the emanation seeds have greatly increased the value of radiation therapy in this disease.

In addition to not advocating any routine treatment for rectal cancer, neither do we advocate any routine dose of radiation therapy; the best results are obtained when each case is considered as an individual problem. The following cases demonstrate that adequate radiation therapy in selected cases is capable of producing "clinical cures." The first case shows that this result may be obtained by external radiation alone, when the cancer is of the most radiosensitive type; the second case, one of a more radioresistant type, responded equally well to interstitial radiation in combination with a small dose of high-voltage roentgen rays.

CASE XIII. *Inoperable carcinoma of the rectum treated by external radiation and colostomy.*

T. H., #36130, male, aged thirty-four, admitted May 1926.

*History* of rectal trouble of six months' duration with attendant loss of 15 lb. in weight. The patient was in an emaciated condition.

*Examination* revealed a large, stenosing, fixed cancer of the upper rectum.

*Pathological* report was ulcerating adenocarcinoma.

*Treatment* began with pelvic cycles of x-radiation, including four portals, the first, May 5 to May 19; colostomy was performed May 29; exploration of the abdomen revealed many enlarged nodes in the mesocolon. Four other x-ray cycles were completed between the dates of June 23, 1926 and April 12, 1927. The intensity of these treatments was 60 min. exposure, 4 ma. of current, filter 0.5 mm. Cu and 1 mm. Al; 200 k. v.; focal distance 50 cm. In addition, the patient received, on January 11, 1927, 20,000 mc.-hr. of radium at 10 cm. from the skin, posteriorly over the sacrum.

The patient has remained free of recognizable diseases for two and one-half years, and is able to carry on his ordinary occupation.

CASE XIV. *Inoperable carcinoma of the rectum treated by colostomy, interstitial and external radiation.*

R. M., #35859, aged sixty-five, admitted March 1926.

*History* of rectal trouble for three months. Colostomy has been constructed at another hospital, February 1926, after the condition was considered inoperable.

*Examination* revealed a large, fixed, stenosing tumor of the upper rectum.

*Pathological* report was adenoma malignum.

*Treatment* consisted in the implantation of 25 gold seeds, a total of 4700 mc.-hr., by way of the anal canal, on March 12, 1926; on March 15, 1926, six gold seeds, totalling 2230 mc.-hrs., were implanted into the upper limits of the tumor by way of the colostomy opening. Between March 17 and April 4, a pelvic cycle of four high-voltage x-ray treatments was given.

*Examination* of this patient in January 1927 failed to reveal any evidence of cancer, and he has remained clinically free of disease to date, more than two and one-half years.

## CANCER OF THE BREAST TREATED EXCLUSIVELY BY RADIATION THERAPY

BURTON J. LEE, Attending Surgeon, Breast  
Department

The treatment of cancer of the breast is often more difficult than that of cancer in other regions of the body, because of the widespread lymphatic system here encountered.

The radical operation has been standard for forty years, yet the results of radical surgery alone, in many clinics, have proved most disappointing. For this reason it has been a part of our plan of treatment of breast cancer to attempt to control this disease, in some cases, by irradiation alone. Certain patients, especially those suffering from other menacing diseases, or whose ages have contraindicated operation, have offered an opportunity for an exclusive treatment by irradiation.

The following cases are presented to give an idea of the type of these patients and to summarize their treatment:

**CASE XV. Primary inoperable carcinoma of the breast treated by radium externally and interstitially in combination with x-rays.**

F. M., female, single, aged thirty-eight, admitted January 1929.

*History* of forcible squeezing of the right breast, June 1928, following which considerable swelling appeared but without ecchymosis. A few weeks before admission the patient first noticed dimpling of the skin over the tumor.

*Examination* by palpation revealed a mass in the upper middle portion of the right breast, measuring  $5 \times 4 \times 2.5$  cm. in diameter, of stony hard consistency, and showing definite skin dimpling over it. Three hard nodes were palpable in the right axilla and there was a questionable node in the right supra-clavicular space. The x-ray film was negative for metastases. The growth was grade c by the Clinical Index of Malignancy.

*Treatment* consisted first in a cycle of four x-ray treatments over the right breast and its drainage areas, given between January 21 and January 31. The exposures were of 360 ma. min., 0.5 mm. Cu and 1 mm. Al filter, 185 k.v., 50 cm. target-skin distance. On

February 4, 1929, there was a slight diminution in the size of the breast tumor. Between February 25 and April 3, 1929, the right



FIG. 7. Case xvii. O. R., #28004. June 9, 1920. Condition of patient on admission.

breast was directly irradiated by the radium element pack for a total of 54,000 mg.-hrs., distributed in five treatments. On June 10, 1929, a marked regression in the size of the tumor was observed. On August 7, 1929, 14 gold radon seeds, containing a total of 29 mc. of radium emanation with a total dosage of 3867 mc.-hrs., were deposited interstitially throughout the tumor, an amount sufficient to distribute five erythema doses in the substance of the tumor.

On September 9, 1929, the tumor was found to have diminished appreciably in size. There have been little or no skin changes induced by this heavy radiation.

**CASE XVI. Primary operable carcinoma of the breast treated by external radium therapy only.**

B. M., female, married, aged fifty-five, admitted July, 1929.

*History* of seven lactations, each of two years' duration. Two weeks prior to admission, the patient had pain in the right breast followed by detection of the mass.

*Examination* revealed a case of primary multiple foci; in the right breast a tumor measuring 3 cm. in diameter could be palpated in the upper outer quadrant in the position of ten o'clock, while a second smaller tumor, 2 cm. in diameter, was found in the upper inner quadrant in the position of two o'clock. The skin was not fixed; both tumors were freely movable; both nipples were erect. Several small nodes were palpable in the right axilla. Roentgenograms of the lungs

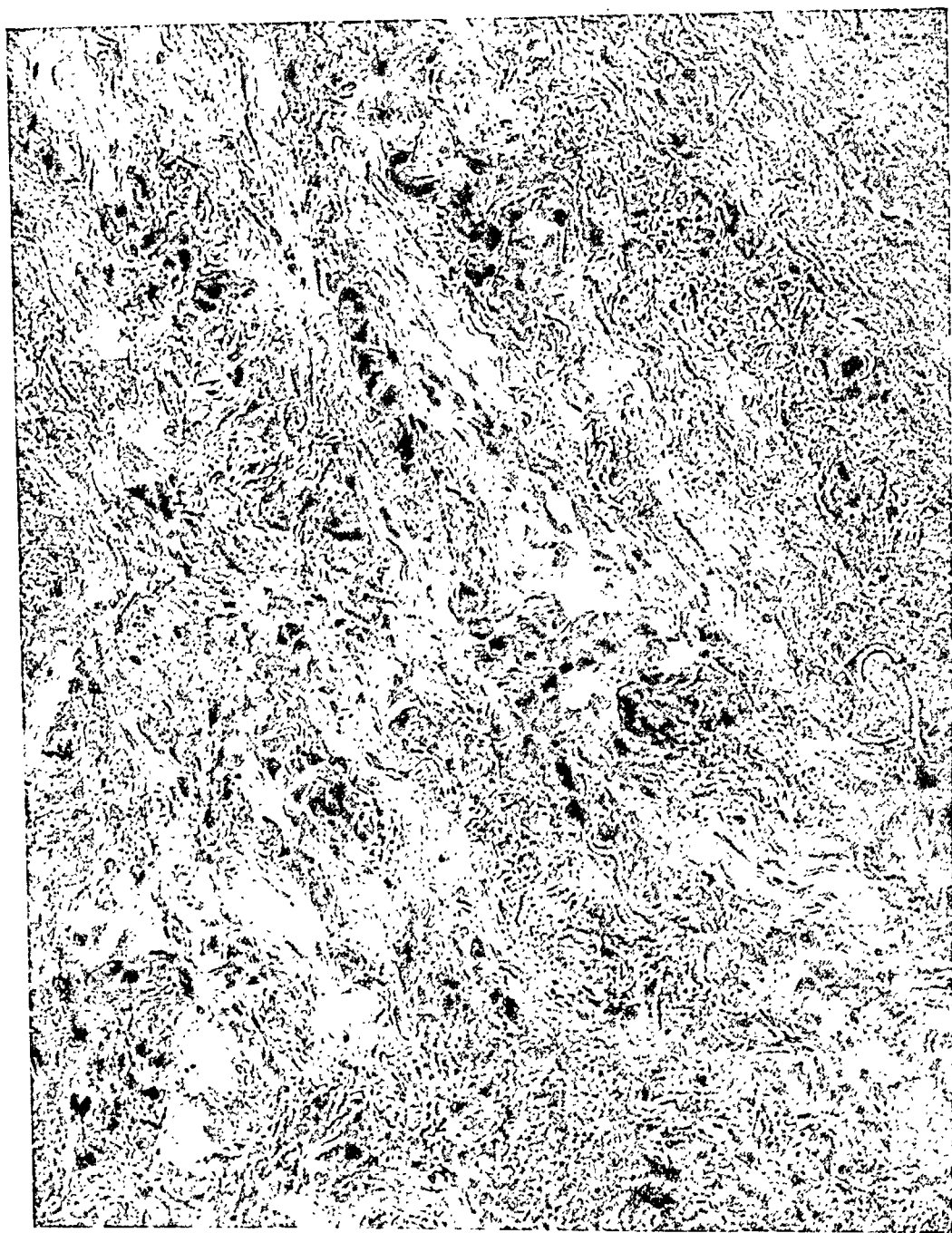


FIG. 8. Case xvii. O. R., #28004. August 1920. Specimen of tumor of right breast. Microscopic diagnosis, carcinoma simplex.

revealed evidence of an old bilateral, apical tuberculosis, but no evidence of metastases.

Treatment consisted in a cycle of six treat-

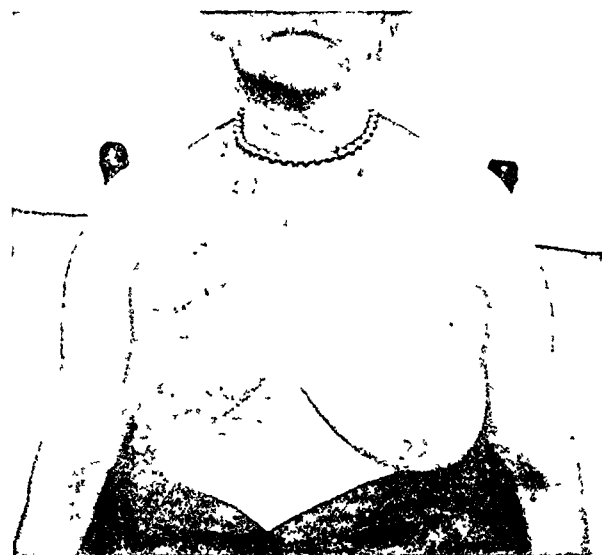


FIG. 9. Case XVII. O. R., #28004. November 1929. Present condition of patient.

ments by the radium element pack, two each to the right breast mesially, the right breast laterally, and the right axilla, totalling 48,000 mg.-hrs., given between the dates of July 7 and August 2, 1929. The breast proper received a total of 32,000 mg.-hrs.; considering the isodosis curve for the radium element pack, the depth dosages for these two breast tumors were as follows:

(1) 120 per cent of an erythema dose throughout the substance of the first tumor, and (2) 130 per cent throughout the substance of the second tumor.

On August 19, 1929, the primary tumor had regressed to one-third of its previous size, a fact which shows that the growths were quite radiosensitive. A radical amputation of the breast is anticipated, five or six weeks after the last treatment.

**CASE XVII.** *Primary operable carcinoma of the breast treated by x-radiation. Histological verification of carcinoma.*

O. R., female, married, aged fifty-seven, admitted May, 1920.

History of two small lumps in the upper part of the right breast for two years previous to admission.

Examination showed a mass,  $3 \times 5$  cm. in diameter, with the skin dimpling over it, in the upper middle segment of the right breast.

There were no definite nodes palpable in the axilla; the chest plate was negative; the general physical examination was negative.

This patient was selected as a test case to determine the efficacy of irradiation in the treatment of a primary operable carcinoma of the breast.

Treatment began May 29 with a cycle of four x-radiations given within a period of ten days, one, each, to the right supraclavicular region, to the right upper anterior chest, to the right lower anterior chest, and to the right axilla. The factors were 35 ma.min., 3 mm. Al filter, 135 k.v. and focal distance 10 inches. By August 4, 1920, there was noticeable diminution in the size of the lesion.

Pathological report from a section removed on August 13, 1920 was carcinoma simplex.

During September and November 1920 and in March, 1921, three other similar cycles of x-radiation using the same factors were given. There has been no further treatment.

At the present time, eight and one-half years later, there is no definite palpable disease. There is a slight thickening throughout the right breast which is believed to have been caused by the x-ray treatments. Marked telangiectasis developed during the past few years, and is at present pronounced.

The patient represents a case of primary operable carcinoma of the breast treated entirely by low-voltage x-rays.

### FIXED PRE-CALCULATED IRRADIATION DOSAGE OF INTRA-ORAL EPIDERMOID CARCINOMA

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#### CASES PRESENTED BY

HAYES E. MARTIN, Assistant Attending  
Surgeon

EDITH QUIMBY, Assistant Physicist

For some time past we have made a detailed study of the tissue doses received by the tumor masses in successfully irradiated cases of intra-oral carcinoma. These investigations have led us to believe

that the lethal dose of the average intra-oral squamous carcinoma lies between seven and ten skin erythema doses, if adenopathy.

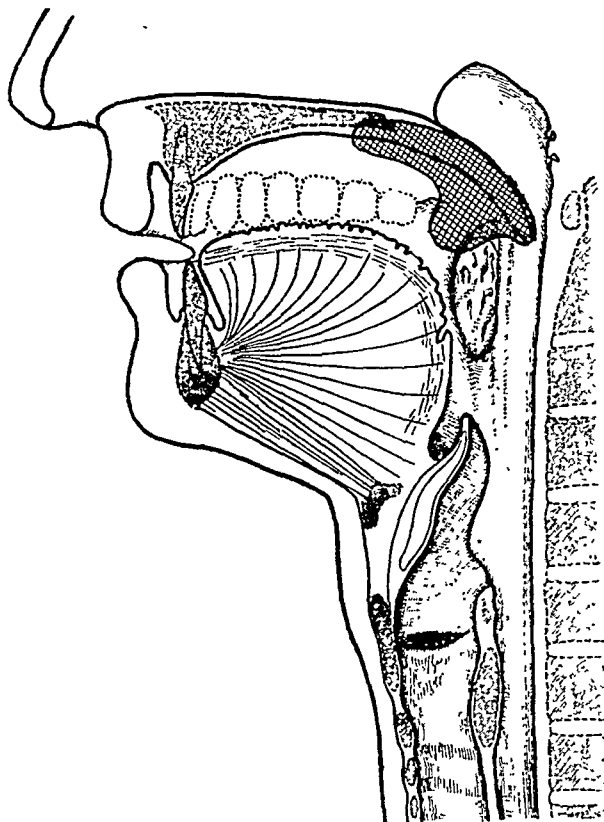


FIG. 10. Case XVIII. C. B., #40290. Cross-hatched area represents cross section of primary lesion in soft palate.

delivered within a period of about ten to twenty days.

Recently we have reversed the process, and in suitable cases have predetermined upon a certain tissue dose to be delivered into the tumor mass. A combination of applicator doses has then been designed so as to produce this desired dose within the tumor. In the 3 cases here presented, radiation therapy was so prescribed.

**CASE XVIII. Carcinoma of the soft palate and anterior tonsillar pillar.**

C. B., #40290, male, aged forty-two, admitted July 15, 1929.

History of severe sore throat of six months' duration, with dysphagia and loss of weight.

Examination showed an irregular, deeply ulcerated, sloughing and granular lesion over 4 cm. in its longest diameter, involving the entire soft palate, excepting the uvula, and extending over onto the left anterior tonsillar

pillar and into the groove between the upper and lower alveolar ridges. There was no adenopathy.

Histological report was squamous carcinoma, grade II.

Treatment by x-rays, emanation pack, and gold seeds, with a predetermined tissue dose of 750 per cent SED, was all given within a period of fourteen days.

**[OUTLINE OF TREATMENT]**

Date	Applicator Dose	Tissue Dose (Per Cent SED)
	X-rays, 165 k.v., 30 cm. target-skin distance 0.5 mm. Cu and 5 cm. oil filter.	
7/17/29	150 ma.-min. to left cheek.	35
7/19/29	150 ma.-min. to right cheek. . . . .	35
	Radium pack at 6 cm. from skin.	
7/25/29	16,000 mc.-hr. to left cheek. . . . .	40
to		
7/28/29	16,000 mc.-hr. to right cheek. . . . .	40
	Total from external sources. . . . .	150
8/ 1/29	Gold seeds: 25.4 mc. in palate. . . . .	600
	Considered as 4 spheres each 2.25 cm. in diameter.	
	Total tissue dose. . . . .	750

**CASE XIX. Carcinoma of the base of the tongue.**



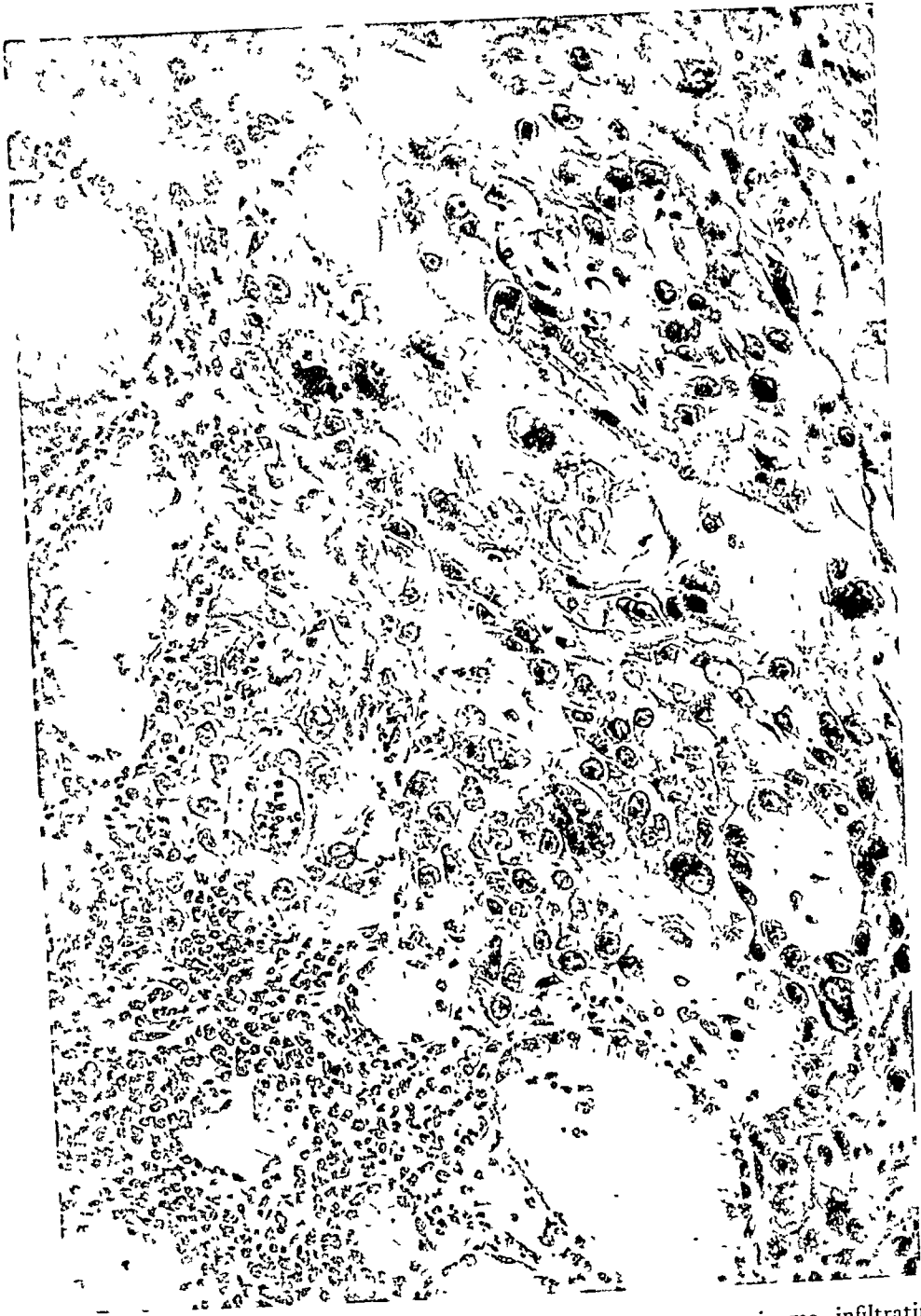


FIG. 11. Case XVIII. C. B., #40290. Section taken on admission. Squamous carcinoma, infiltrating adult type, grade II, radioresistant.

T. M., #40726, male, aged forty-nine, admitted July 9, 1929.

History of soreness of the right posterior

of 900 per cent SED, was given by the radium element pack and interstitial gold seeds within a period of nine days.

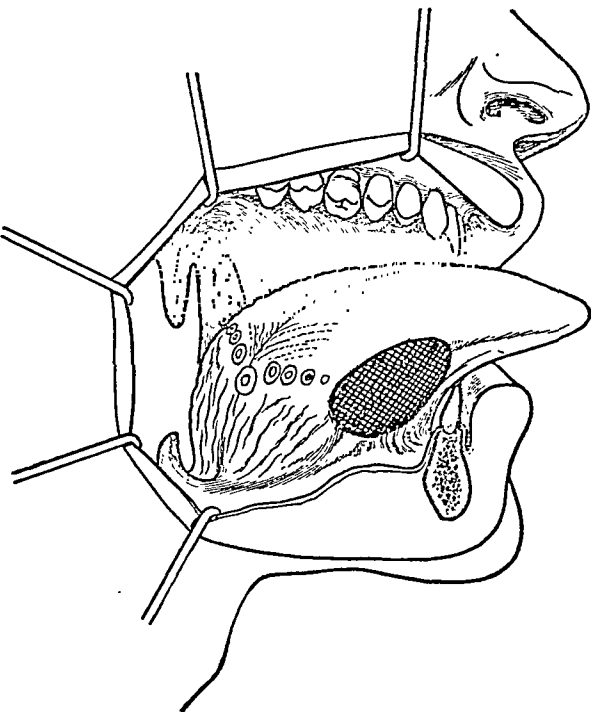


FIG. 12. Case XIX. T. M., #40726. Cross-hatched area shows location of primary lesion in tongue.

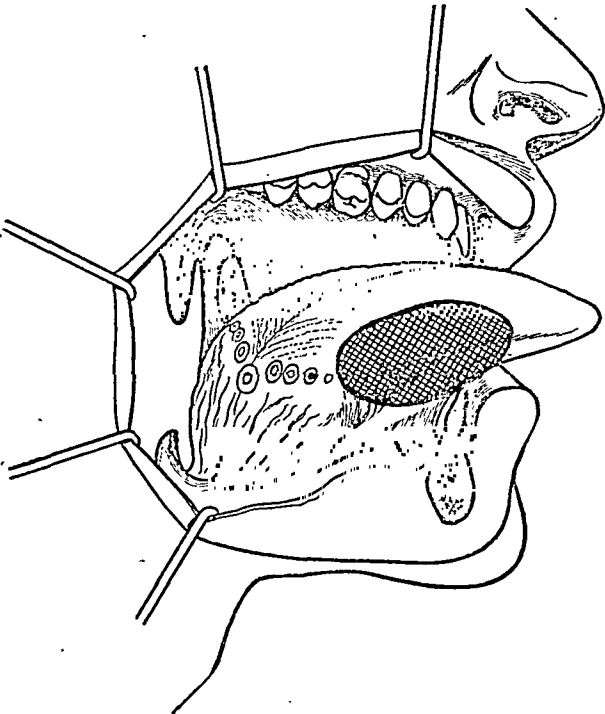


FIG. 14. Case XX. G. E., #40488. Cross-hatched area shows location of primary lesion in tongue.

lateral border, beginning six months ago, and increasing in intensity one month ago.

Examination showed an ulcerated, granular, fissured lesion 3 to 3.5 cm. in its longest diameter, located on the right edge of the tongue opposite the anterior tonsillar pillar, and extending up onto the pillar and the mucosa on the inner side of the alveolar process. The lesion had infiltrated the tongue quite deeply and had excavated the anterior tonsillar pillar. There is no adenopathy.

Histological diagnosis was epidermoid carcinoma, grade II, moderately radiosensitive.

Treatment with a predetermined tissue dose

CASE XX. Carcinoma of the base of the tongue.

G. E., #40488, male, aged sixty-five, admitted May 25, 1929.

History of a sore on the tongue of four months' duration.

Examination showed a flat, indurated lesion of the right base of the tongue extending

OUTLINE OF TREATMENT

Date	Applicator Dose	Tissue Dose (Per Cent SED)	
		Primary	Node
	X-rays, 165 k.v, 50 cm. target-skin distance 0.5 mm. Cu and 5 cm. oil filter.		
5/25/29	360 ma.-min. to right neck.....	80	95
5/29/29	360 ma.-min. to left neck.....	60	45
	Total from external source.....	140	140
5/31/29	Gold seeds: 29 mc. in tongue.....	900	180
6/ 6/29	Gold seeds: 8 mc. in submaxillary node.....	50	1000
	Total from buried sources.....	950	1180
	The primary lesion was considered as a sphere 3.5 cm. in diameter, the node as a sphere 2 cm. in diameter, their centers 3.5 cm. apart.		
	Total tissue dose.....	1090	1320

OUTLINE OF TREATMENT

Date	Applicator Dose	Tissue Dose (Per Cent SED)
	Radium element pack.	
7/9/29	16,000 mg.-hr. to right neck.....	65
to		
7/16/29	16,000 mg.-hr. to left neck.....	45
	Total from external sources.....	110
7/18/29	Gold seeds in tongue, 26 mc.....	80
	Considered as 3.5 cm. sphere.	
	Total tissue dose.....	920

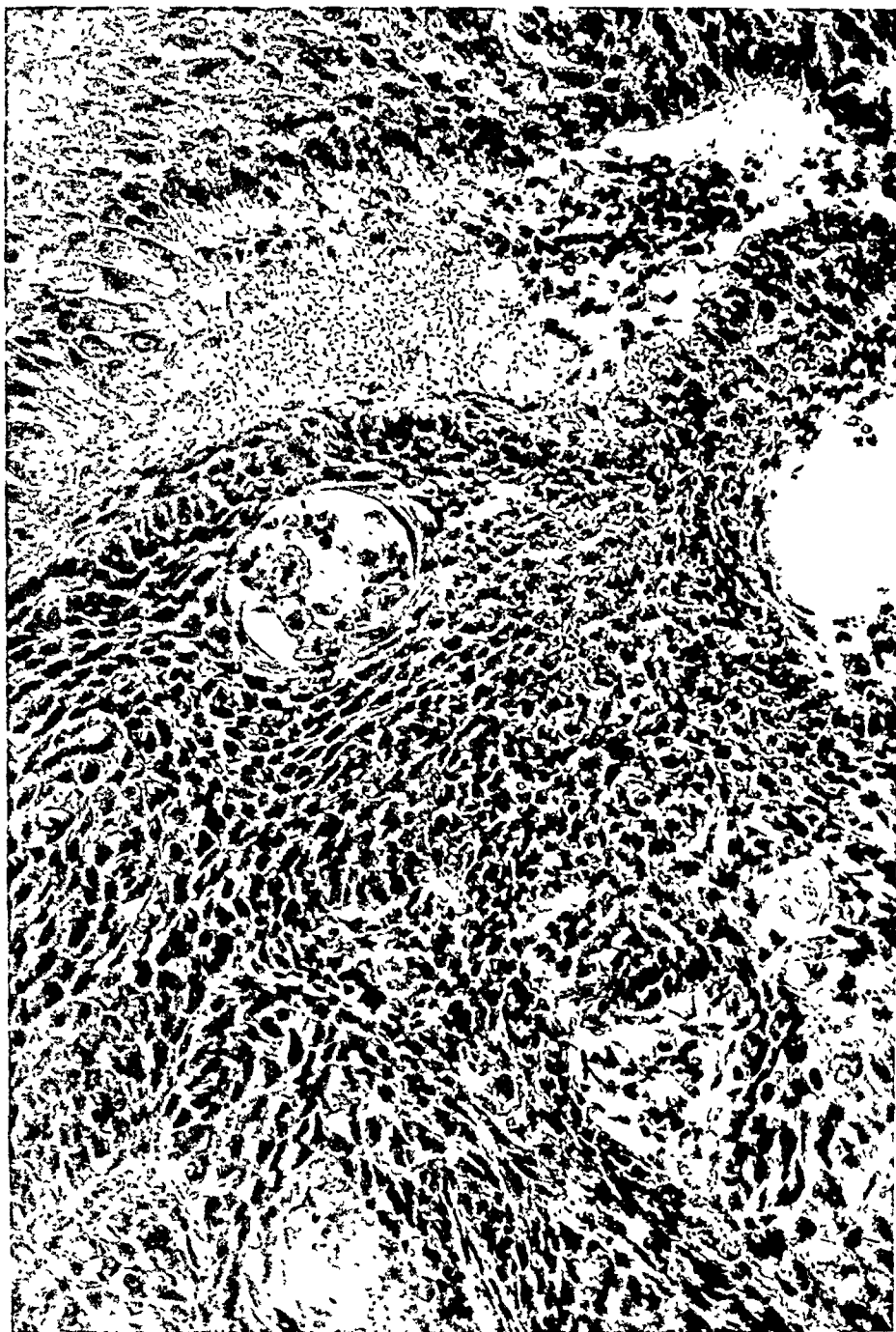


FIG. 13. Case XIX. T. M., #40726. Section taken on admission. Epidermoid carcinoma, grade II, moderately radiosensitive.

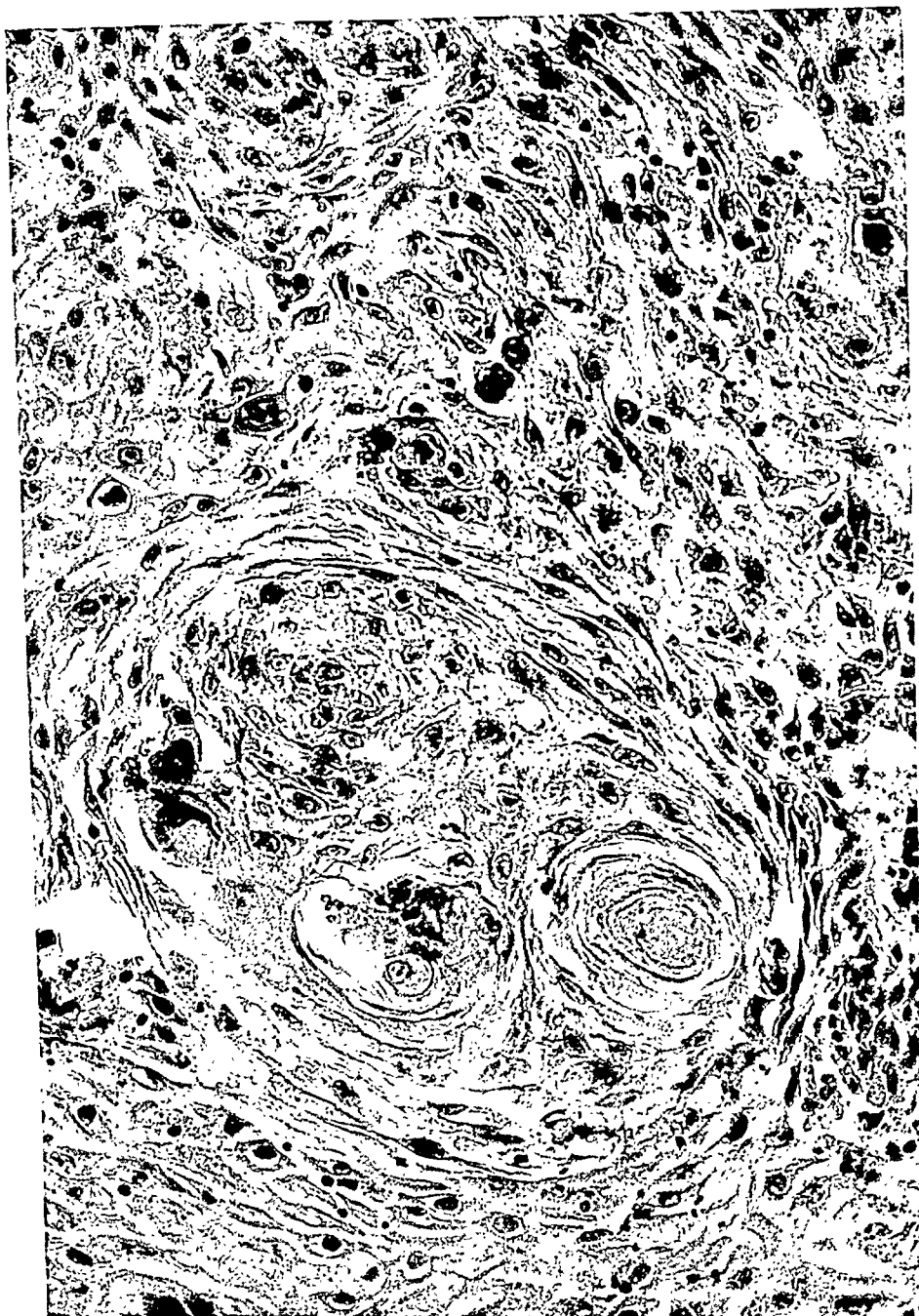


FIG. 15. Case xx. G. E., #40488.<sup>1</sup> Section taken on admission. Squamous carcinoma, grade II, radioresistant.

forward from the level of the anterior tonsillar pillar,  $3.5 \times 2 \times 1.5$  cm. in size. One metastatic node, 1.5 cm. in diameter, was palpable in the right submaxillary region.

*Treatment* with a predetermined tissue dose of 1,000 per cent SED, was given by x-rays and gold seeds interstitially, within a period of ten days.

## SOME TYPES OF RADIORESISTANT TUMORS WITH RESULTS OF TREATMENT

JAMES EWING, Pathologist and Director of Cancer Research

The main object of demonstrating these tumors is to emphasize the following points: first, that the factors entering into radioresistance are very varied; second, that each tumor must be analyzed by itself in accordance with its known structure and clinical behavior; and third, that the results to be attained by radiotherapy in these tumors must be considered in the light of all the factors. Growth restraint is generally all that should be attempted.

**CASE XXI. Osteogenic sarcoma devitalized by radiation.**

I. D., #31034, female, aged twenty-five, admitted August 29, 1922.

*History* of an injury to the thigh, nine months earlier, causing severe neuralgic pain which recurred, after disappearing, together with a small lump at the site of the injury. The growth has increased in size in spite of sixteen electric treatments.

*Examination* showed a large osteogenic sarcoma of the lower end of the femur. It was a typical bone former, and had destroyed the lower 6 inches of the shaft and produced a large swelling of the leg.

*Treatment* by means of thirteen exposures to high-voltage x-rays, over a period of one year, devitalized the tumor and stopped its growth, but did not reduce its size. Spontaneous fracture occurred two and one-half years after onset, and this event led to amputation. Examination revealed a large central cystic cavity surrounded by a shell of tumor tissue, in which the tumor cells were largely replaced by fibrous tissue. No actively growing portions of tumor could be found. There were no metas-

tases. The patient is well eight years after the onset of the disease.

This case illustrates the devitalization of a highly resistant tumor by prolonged treatment, and it is believed that the radiation was a factor in preventing the usual metastases. Resistance was due to fibrous and osteoid stroma, bulk of tumor, lack of blood vessels, and protection against invading reactive tissues and cells by the capsule.

**CASE XXII. Medullary fibrosarcoma. Marked growth restraint and reduction in size of a highly resistant tumor.**

B. M., #26304, female, aged thirty-three, admitted March 13, 1919.

*History* of onset of rheumatic pain in the right knee, one year ago, followed, six months later, by a sudden swelling of the knee. The tumor was excised in January 1919.

*Examination* revealed a tumor at the lower end of the femur, destroying the shaft, and producing a mass 6 cm. in diameter.

*Histological report* (1921) was of a markedly fibrous spindle-cell sarcoma.

*Treatment*, consisting of several series of deep x-ray treatment over a period of three years, caused cessation of growth and reduction in size, but the bone failed to regenerate, and a fibrous mass remained. Amputation was performed in March 1924. The patient has been well for eight years. Resistance was due to the fibrous avascular character of the stroma.

**CASE XXIII. Benign bone aneurysm of the lower end of the femur. Devitalization by radiation, but increase in size because of aneurysmal dilatation.**

M. G., #30720, female, aged thirty-five, admitted June 13, 1922.

*History* of a fall and slight cut on the knee, a year previously. Several months later the knee swelled and dull local pain and sharp pain in the foot and ankle have been continuous, in spite of baking and massage. The leg was put up in plaster for eight weeks, until six weeks ago.

*Examination* showed a tumor of the femur with rather characteristic radiological signs of giant-cell tumor.

*Treatment* by routine external radiation failed to check the steady increase in size of the growth, which became of very large dimensions, simulating malignant growth. Amputation was performed June 1924, and after this, the

anatomical study revealed a bone aneurysm with free communications with the large arteries together with large cysts filled with fluid and clotted blood, and tumor septa of fibrous nature.

*Pathological examination* revealed that most of the tumor tissue had been destroyed, while the remainder showed traces of giant-cell structure and calcification.

The patient has remained well for four years. The radioresistance is apparent, not real.

CASE XXIV. *Neurogenic sarcoma, imperfectly treated with radiation without result.*

C. T., #39811, female, aged thirty-three, admitted February 28, 1929.

*History* of a small swelling near the right elbow, first seen three months ago. Under some form of electrical treatment, the pain and swelling, and disability of the elbow and hand, steadily increased. Two weeks ago, the tumor was surgically removed.

*Examination* revealed a rapidly growing sarcoma of the upper arm, involving nerve trunks, muscle, and fasciae.

*Treatment* consisted in the application of 24,000 mc.-hr. of radium at 10 cm. distance, and two high-voltage x-ray treatments. Coley's toxins were administered. As no result appeared in a few weeks, the arm was amputated. There was prompt recurrence in the stump, and the patient died with pulmonary metastases.

*Microscopical examination* showed a very cellular tumor, with polyhedral type cells, and much resistant fibrous stroma.

The case illustrated a resistant tumor, imperfectly treated, with too brief a time of observation. Genuine radioresistance is not proved in this case.

CASE XXV. *Neurogenic sarcoma, very cellular, but very fibrous and resistant.*

M. P., #39156, female, aged thirty-six, admitted September 18, 1928.

*History* of a swelling of the thigh, first noticed ten months ago, and operated upon, March 1928, with a diagnosis of spindle-cell fibrosarcoma.

*Examination* showed a hard, smooth tumor mass, 5 cm. in diameter, deep between the muscles of the thigh.

*Treatment* amounted to 61,000 mc.-hr. of radium externally, and 40 mc. interstitially. Coley's toxins were given. As there was no definite regression over a period of four months, amputation was done.

*Microscopic section* showed that the tumor was composed of large spindle cells, very fibrous and very radioresistant.

CASE XXVI. *Liposarcoma of the capsule of the knee joint, resistant after considerable treatment by radium and x-rays. Excision, recurrence and amputation.*

The patient, a female, thirty-five years old, presented a large, firm, lobulated tumor of the knee joint, 12 cm. in diameter. It was treated over a period of six months by x-rays and radium, at moderate intervals. The dosage is not known, but it was not sufficient to affect the skin. There was no regression and the tumor was excised. On section it showed many large polyhedral cells, granular, but containing many fat droplets. The cause of the apparent radioresistance is not apparent, but the dosage seems to have been too small. Other liposarcomas have responded to radiation.

CASE XXVII. *Induced resistance in a diffuse endothelioma of the tibia, after radiation.*

E. V., #28456, male, aged seventeen, admitted December 8, 1920.

*History* of slow intermittent ache, beginning a year ago, and followed after a few months by a swelling of the tibia. This was incised November 1920, for a supposed osteomyelitis.

*Examination* showed a fusiform swelling of the upper end of the tibia. Microscopic section (from incision) showed diffuse endothelioma.

*Treatment* consisted of radium packs, given over a period of one year. Regression was apparently complete. Three years later there was a recurrence of the growth at the upper end of the tumor area and amputation was done.

*Section* revealed that the main tumor had been rendered highly fibrous and quiescent, but that the fibrous tissue contained many groups of well-stained viable tumor cells. The conditions represent abortive fibrosis. At the upper end of the tibia, where there was no fibrosis, the tumor cells were growing actively.



# ROENTGENOLOGIC OBSERVATIONS ON BENIGN TUMORS OF THE STOMACH\*

WITH A REPORT OF FIFTEEN CASES

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**B**ECAUSE of their comparative rarity, non-malignant tumors of the stomach may seem to be a rather academic subject for discussion. Eusterman and Senty<sup>1</sup> estimated some years ago that only 1.3 per cent of all the tumors of the stomach coming to operation were benign. This probably was only an estimate of those tumors which produced symptoms or were accidentally discovered. That they are in reality much more common than this is attested by the fact that the total of reported cases is now approaching a thousand. Eliason and Wright,<sup>2</sup> for example, report 50 personal cases. Pendergrass<sup>3</sup> has seen 30 cases of the pedunculated type alone. During the past two years the author has seen 11 cases in a comparatively moderate number of gastro-intestinal examinations which included some 74 cases of gastric carcinoma.

Hillstrom<sup>4</sup> in a study of records of the Department of Pathology of the University of Minnesota found that about 5 per cent of all the tumors discovered at post mortem or removed at operation were benign. These figures indicate, therefore, that the condition is not a rare one.

Neither operative or post-mortem statistics, however, present a true picture of the frequency of benign gastric tumors because numerous factors of error are present. They may be unrecognized at operation if the stomach is not opened; they are frequently symptomless; they often become malignant and may not come to operation or post mortem until such carcinomatous degeneration has occurred. There is no doubt that their recognized incidence will increase greatly with the increase in our diagnostic accuracy.

Furthermore, it appears necessary, as in many uncommon conditions, that particular attention be paid to their recognition or they may be frequently overlooked.<sup>2,5</sup>

The importance of benign gastric tumors is two fold. They may produce symptoms of marked severity, incapacitating the individual who is suffering from this condition. They frequently show malignant degeneration and are very probably the origin of many cases of the polypoid type of gastric carcinoma. Their surgical removal in most cases is comparatively simple and the end-results are so excellent<sup>6</sup> that their early recognition becomes a matter of the utmost importance.

The literature has been reviewed so well by Eliason and Wright,<sup>2</sup> Moore,<sup>5</sup> and Balfour and Henderson<sup>6</sup> that it need not be further discussed here. These authors discuss the types of tumors and their relative incidence in detail. Only one factor in the etiology stands out. This concerns itself with the close relationship of chronic gastritis and the hypertrophied gastric mucosa to benign polyps and polyposis of the stomach. It seems highly probable that chronic gastritis may develop into polyposis if sufficiently severe. The hypertrophied gastric mucosa resembles a polyp so closely that the clinical or even roentgenological differentiation is very difficult.

Benign tumors of the stomach may be classified pathologically as follows: multiple polyposis, angioma, myoma, fibroma, papilloma, polyp, myoma, fibromyoma, cysts, hypertrophied mucosa, and several other very rare types. From the clinical and roentgenological point of view they are

\* From the Department of Roentgenology of the University of Minnesota, the University Hospital and The Minneapolis General Hospital, Minneapolis, Minn. Read before the Hennepin County Medical Society, Oct., 1928.

more simply classified as polypi, ball-valve tumors, angiomata, myomata, and multiple polyposis. The ball-valve tumors

lated tumors especially there may be paroxysmal gastric pain with prostration, vomiting and anorexia. Anemia and weight

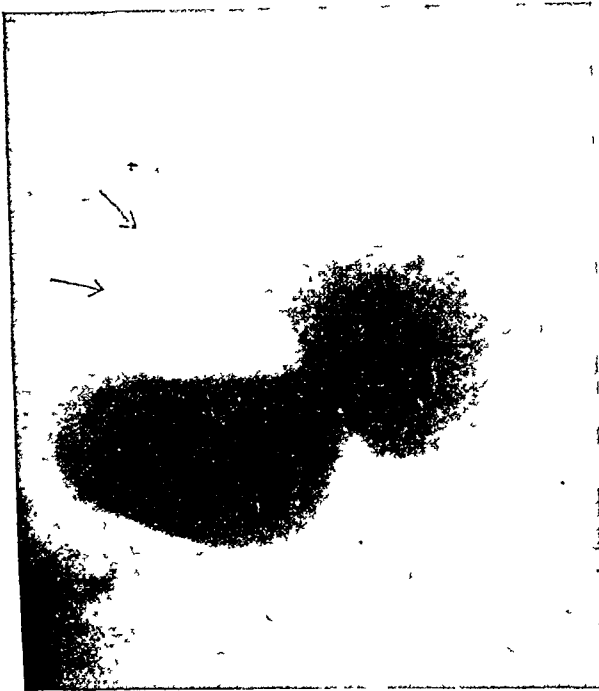


FIG. 1. Roentgenogram of stomach and duodenum showing large, central, sharply outlined defect in duodenal bulb. Note thin rim of barium surrounding tumor defect. Defect was due to pedunculated gastric polyp which prolapsed through pylorus.

are pedunculated, attached near the pylorus, and tend to prolapse through the pylorus into the duodenum. They often cause obstruction and roentgenologically may simulate a duodenal tumor.

The symptomatology depends, obviously, upon the size, multiplicity, location and character of the tumor, and as to whether or not ulceration is taking place. In general the symptoms are due to hemorrhage, obstruction, ulceration, or disturbance of gastric function. Eliason and Wright give four groups of symptoms: (1) Indefinite gastric disturbances with pain over a long period relieved by frequent feedings. There may be progressive weight loss, anemia, hematemesis or melena. (2) Symptoms of acute gastritis or ulcer with intermittent hemorrhages and weight loss. (3) Palpable mass with the patient feeling heavy lumps, nausea, and other signs of obstruction. (4) In the peduncu-

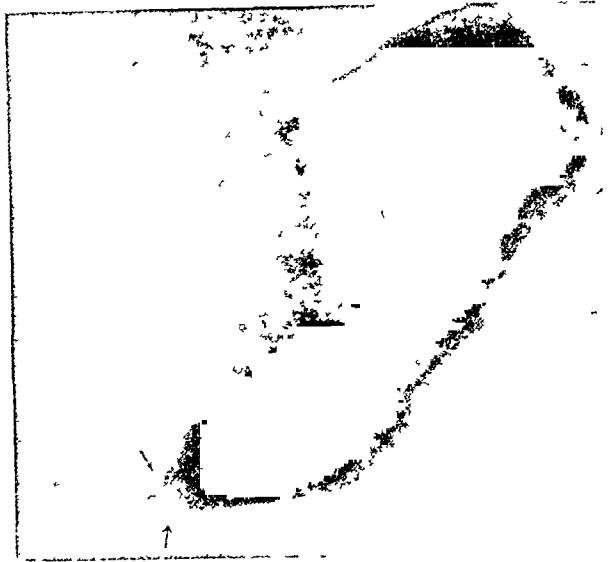


FIG. 2. Roentgenogram of stomach showing carcinomatous infiltration on greater curvature in middle third and single polyp in prepyloric region near greater curvature. Note irregularity of malignant infiltration and involvement of contour. Defect due to benign polyp is round, central, sharply outlined and entirely distinct from carcinoma.

loss may or may not be present. It is characteristic of this group that complete recovery may take place until the next attack. The latter group of symptoms may occur with the simple type of hypertrophied gastric mucosa which may prolapse through the pylorus just as would a pedunculated tumor.

The physical signs are essentially negative. It is rare that the mass can be palpated and then only in the exogastric type.

The laboratory findings are not at all consistent. Achylia gastrica is frequent, especially in the cases of generalized polyposis. A secondary anemia which occasionally simulates a primary anemia in its blood picture is present. Blood in the gastric contents has been found, and in a few cases tumor tissue.

The differential diagnosis must be made from carcinoma, ulcer, gastritis, pernicious anemia, and functional dyspepsia.

The roentgen examination with the barium meal is by far the best method



of establishing the diagnosis. In the symptomless cases, which are frequent, it is the only feasible method. It is only in

through the gastric walls in the region of the defect (Fig. 5). (3) The gastric walls are flexible in the region of the tumor. (4) The

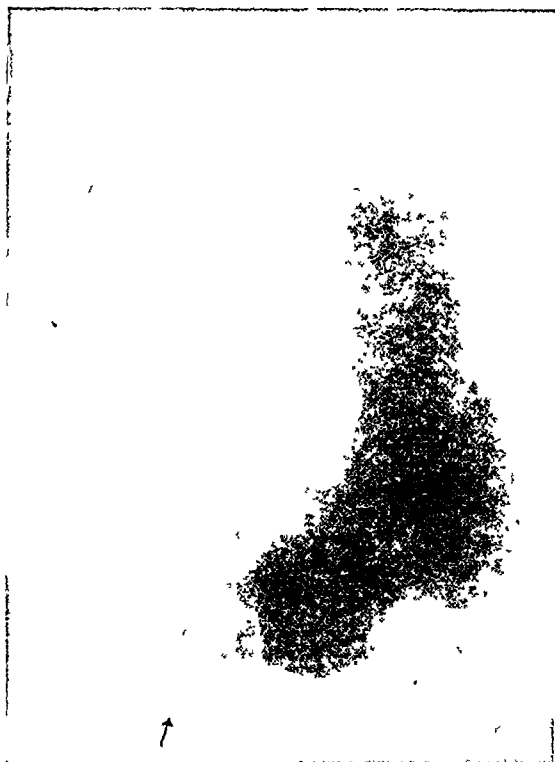


FIG. 3. Roentgenogram of stomach showing typical ulcer niche on lesser curvature in middle third and benign polyp in prepyloric region near greater curvature. Defect is central, sharply outlined, round. Peristalsis passed unhindered through this area.

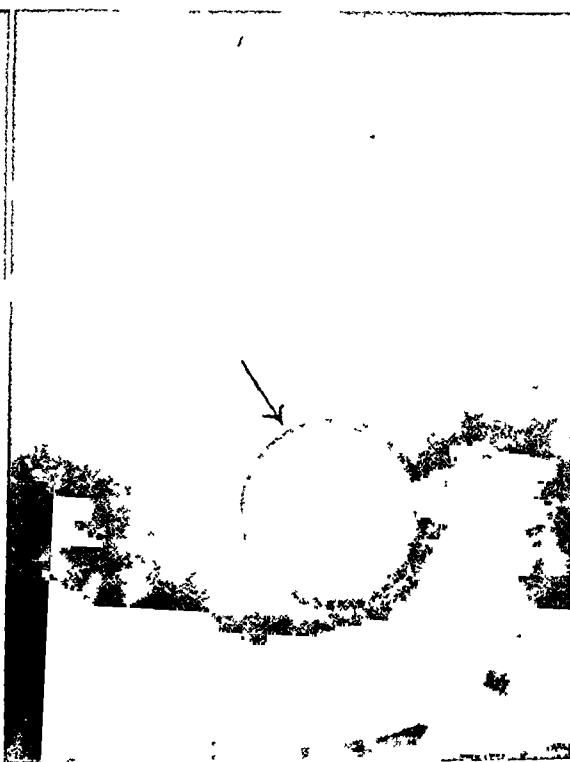


FIG. 4. Roentgenogram of stomach showing multiple polyposis. Sponge-like appearance of stomach is well shown. There are numerous rounded defects, one of which is well shown by pressure applied by palprium (lead ring). Note generalized involvement. Peristalsis was present normally.

recent years that benign gastric tumors have been recognized prior to operation or post mortem. Moore,<sup>5</sup> for example, states that very few cases were diagnosed correctly prior to 1924 at the Mayo Clinic while at present they seldom make an error in this condition. In one series of 50 cases reported<sup>2</sup> only 6 had been studied roentgenologically and of these only one was correctly diagnosed. With the use of the proper technic very few cases should escape diagnosis and the only error that may be frequent is the confusion with the polypoid types of carcinoma.

The roentgen signs depend upon the size, shape, location and number of the tumors. The principal findings are as follows (1). A filling defect which is usually central, round or oval, sharply outlined, smooth in contour (Fig. 1). (2) Peristalsis passes

defect itself is frequently movable. (5) A pedicle may be demonstrated. (6) The defect may appear in the duodenal bulb if the tumor prolapses through the pylorus (Fig. 1). (7) The lumen of the stomach is not decreased in size (Figs. 5, 6b, 8). (8) Pyloric obstruction with six-hour gastric retention may be present. (9) In cases of polyposis the barium shadow of the stomach may show numerous small defects resembling a sponge (Fig. 4). (10) In cases of hypertrophied gastric mucosa, the defects may appear as ridges of exaggerated type (Fig. 9). (11) The rugae above and around the tumor may be unaffected.

The technic of examination is of the first importance. Overfilling of the stomach with the barium meal must be avoided and a roentgenoscopic examination with only a

few swallows of barium is necessary. This is well illustrated in Figures 6a and 6b, which are from the same case. The typical defects

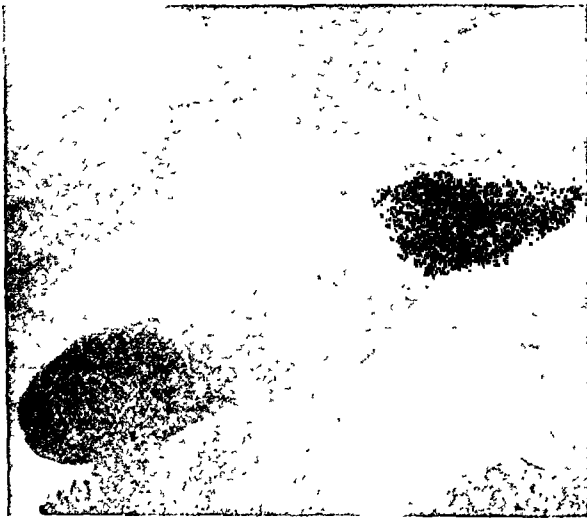


FIG. 5. Roentgenogram of stomach showing multiple benign tumors, probably polypi, in middle portion of stomach. Note sharply outlined, central, rounded defects with some evidence of rugae still present distal to tumors. Defects are brought out by pressure.

overfilled as shown in Figure 6b. A similar case is shown in Figure 7. Manipulation of the stomach is of great importance, especially to produce pressure. In this way, as shown in Figures 4, 5 and 6a the defects can be much more clearly seen. Furthermore the mobility of the tumor can be thus demonstrated and in the pedunculated type actual displacement through the pylorus can be produced as previously reported by the author.<sup>7</sup> The examination must be made both in the upright and prone positions. The observation of peristalsis and flexibility of the gastric walls is of great importance.

Roentgenologically, benign tumors must be distinguished from retained food particles, foreign bodies such as hair balls, gastritis and carcinoma. Food particles are more freely movable, not so round or sharply outlined, and can be eliminated by repeated examination. Foreign bodies are usually larger, more mobile, and

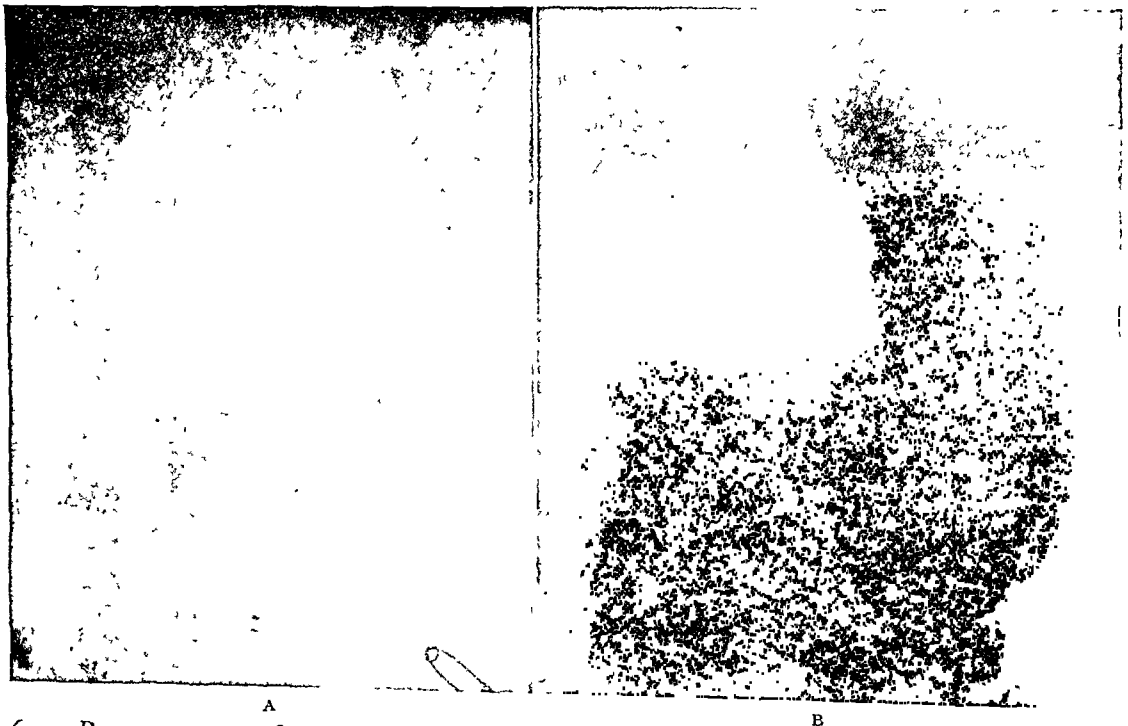


FIG. 6. A. Roentgenogram of stomach only slightly filled showing multiple defects characteristic of benign tumors. These are brought out well by pressure, were somewhat moveable roentgenoscopically. B. Same case showing obliteration of defects in barium shadow due to overfilling of stomach.

shown in Figure 6a were completely lost a few minutes later when the stomach was

produce downward sagging of the stomach. Gastritis may be difficult to distinguish

from multiple polyposis and in the severe cases the differentiation is impossible. The multiple defects in gastritis are long



FIG. 7. Roentgenogram of stomach showing multiple polypi in middle third, brought out well by pressure. At operation, palpation of the stomach revealed no tumors but multiple polypi, with malignant degeneration on their surface, were found when stomach was opened. Note sharply outlined rounded defects with contours of stomach undisturbed.

and narrow rather than round in shape. They are tortuous, take on the form of large rugae and are likely to be more widely distributed. Carcinoma is not sharply demarcated, not mobile, does not permit peristalsis to pass through the gastric wall in its region, obliterates the rugae about it, prevents flexibility of the gastric wall, and often produces a reduction in the lumen of the stomach. Carcinoma rarely remains as a central defect but usually involves the contours of the stomach. Carcinomatous degeneration of a benign tumor may not change its roentgenologic appearance although occasionally infiltration of the wall becomes apparent after malignancy supervenes.

It must be borne in mind that benign tumors may be present in association with other pathological conditions, especially carcinoma. A case of this type was reported previously by the author<sup>8</sup> and another of the same kind is illustrated in

Figure 2. The association of ulcer and benign tumor may also be demonstrated as shown in Figure 3.

We have been able to collect from our own material 13 cases of benign gastric tumors, 2 cases which were clearly multiple polypi but which on microscopic examination showed malignant degeneration on their surface, and 4 cases of chronic gastritis verging on polyposis. Not all of these cases have been proved by operation or autopsy but in every case reported the roentgenologic and clinical findings are so clear that there is little doubt as to the correctness of the diagnosis.

In this group of cases there are only 6 showing a single tumor. Three of these have been proved to be polyps by pathological examination while the other 3 are characteristic. One of these (previously reported) is shown in Figure 1. The large, sharply outlined defect in the duodenal bulb is characteristic of a pedunculated polyp which has prolapsed through the pylorus. In 2 of these cases carcinoma was present elsewhere in the stomach but having no connection with the benign tumor. One of these has been previously reported.<sup>8</sup> The other is shown in Figure 2. The small, rounded, sharply outlined filling defect, just prepyloric, is typical of a single polyp. On the greater curvature in the middle third a carcinomatous infiltration can be made out. Between it and the polyp the gastric wall was pliable and peristalsis passed through it unhindered. In another case there was associated with a single polyp, but entirely independent of it, a large penetrating ulcer on the lesser curvature. This is illustrated in Figure 3, the polyp again being just prepyloric while the ulcer is in the middle third. This patient also had a carcinoma of the esophagus. The remaining 2 cases were uncomplicated, single polypi.

One case of generalized polyposis was found in this group. The classical appearance of this condition is well illustrated by this case (Fig. 4). Note the spongy appearance of the barium shadow, the numerous rounded filling defects. The clear way in

which one of these is brought out by the application of pressure is well shown. There were 7 cases of multiple tumors

are entirely lost. In this group there were 2 cases in both of which a diagnosis of multiple polypi was made but malignant

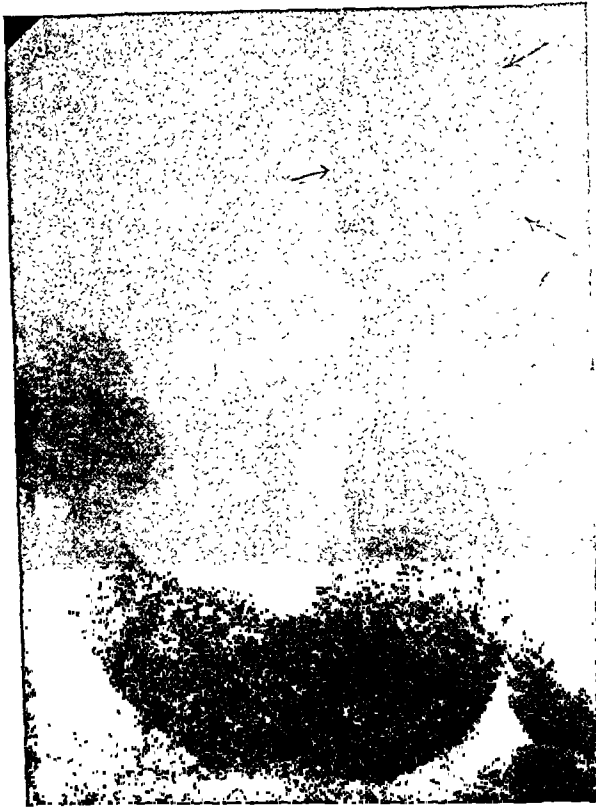


FIG. 8. Roentgenogram of stomach showing large central, rounded, sharply outlined defect in cardiac end. Thought to be due to large fibromyoma but not finally proved.

fairly well localized to one portion of the stomach. A typical one of these is illustrated in Figure 5. The tumors resemble polypi also; they are rounded, sharply defined, are well brought out on pressure and seem to be localized to the middle third of the stomach. One of these cases illustrates very well the extreme importance of examining the stomach with only a small amount of barium and with pressure because these small defects can be so easily obliterated by overfilling. Figure 6a represents the stomach with only 1 oz. of the opaque mixture in it, the film being taken with pressure applied by a palparium. Three distinct and characteristic defects are made out. In Figure 6b the same stomach is shown taken at the same sitting except that it is now filled up with the usual 6 oz. of mixture. The defects

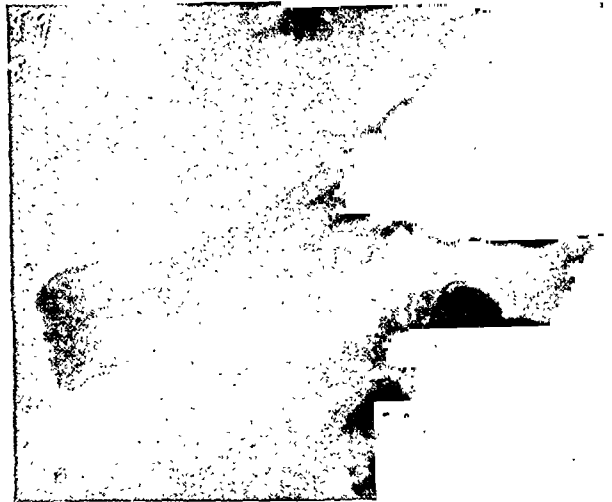


FIG. 9. Roentgenogram of stomach showing marked increase in size of rugae representing appearance of chronic gastritis. Region of pylorus suggests hypertrophied gastric mucosa with possibly some prolapse through pylorus indicated by defect in duodenal bulb. Clinical findings were characteristic.

degeneration of their surface was found on pathological examination. In one of these cases (Fig. 7) an experienced gastric surgeon pronounced the stomach negative after careful palpation during a laparotomy. The patient would have been closed up without any resection if it were not for the confidence placed in the roentgen findings. On opening the stomach multiple papillomata were found which on microscopic examination showed carcinomatous changes.

One case, with a very large tumor of the cardiac end of the stomach, the nature of which was never determined, is included in this series. The sharp demarcation, lack of involvement of the contours, central position and rounded character of this defect (Fig. 8) all indicate that it is benign. The clinical findings support this view very strongly. We have been unable to prove our findings in this case.

Four cases which showed markedly hypertrophic gastric rugae complete this series. In several of these there is considerable doubt as to whether the case is one of polyposis or gastritis. One of these, diag-

nosed polyposis, came to post mortem and was found to have markedly hypertrophic rugae but no true polypi. The pathological difference, however, is not definite. One of these cases (Fig. 9) gave the classical group of symptoms described by Eliason, Pendergrass and Wright,<sup>9</sup> indicating occasional prolapse of a segment of hypertrophic mucous membrane. The marked increase in the shadows of the rugae is well shown in this case. The linear character of these defects tends to distinguish them from polypi.

#### SUMMARY AND CONCLUSIONS

Nineteen cases are here reported in which benign lesions of the stomach have been roentgenologically diagnosed. These include 13 cases of benign tumors, 2 cases of benign polypi with malignant degeneration, and 4 cases of hypertrophic gastritis verging on polyposis.

Benign tumors of the stomach are more common than is generally realized.

Their recognition is of great importance because of their tendency to become carcinomatous and because their surgical treatment is so favorable.

The roentgen examination is the best, and often the only, means of diagnosis.

Careful study with small quantities of the opaque mixture and with the application of pressure over the stomach will usually reveal the tumors. It is possible to demonstrate the number, situation and character of the tumors and prolapse through the pylorus may also be diagnosed.

Carcinoma and ulcer may be present in the stomach coincidentally.

Chronic hypertrophic gastritis may give an appearance similar to polyposis and frequently is difficult to distinguish from it.

Thanks are due Dr. Walter H. Ude for assistance in the preparation of this paper and for the privilege of reporting the case illustrated in Figure 8.

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# STEREOROENTGENOMETRY

A METHOD FOR MENSURATION BY MEANS OF THE ROENTGEN RAY\*

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I HAVE previously described an apparatus and a method<sup>1</sup> for mensuration by means of the roentgen ray. It is my purpose to present a new name for the procedure, to describe a new instrument with its mechanical perfections, to give in some detail the technic of its operation, and to summarize the results of its application to some of the problems of diagnosis.

## DEFINITION

Stereo-roentgen-ometry: a process for determining the solid dimensions of a radio-opaque object from its stereoscopic roentgenograms.

Stereo-roentgen-ometer: an instrument used in stereoroentgenometry.

## BASIC PRINCIPLE

In Figure 1,  $xy$  represents a radio-opaque object in space, somewhere between the target  $r$  of the  $x$ -ray tube, and the film  $F$ . When the target is at position  $A$ , the shadow of  $xy$  will be cast on the film  $F$  as  $Ax Ay$ . When the target is at position  $B$ , the shadow of  $xy$  will be cast on the film  $F$ , as  $Bx By$ .

Stereoroentgenometry involves the mechanical reproduction of these conditions. As constants, we have the shift of the target  $AB$ ; the vertical target film distance  $AF$ ; and the double exposed roentgenogram  $F$ , upon which is the shadow of the special marker  $SM$ , whose relation to the two positions of the target is known. An apparatus is then designed whereby the relative positions of  $x$  and  $y$  are established in space, and the distance between them measured directly. In practice a film is used for each exposure, then the two roentgenograms are exactly superimposed according to the shadows of  $SM$ .

<sup>1</sup> Johnson, C. R. Mensuration and localization by means of the roentgen ray. *Radiology*, June, 1927.

\* Read in part before the Section on Obstetrics, Gynecology and Abdominal Surgery at the Eightieth Annual Session of the American Medical Association, Portland, Ore., July 10, 1929.

## THE STEREOROENTGENOMETER

The stereoroentgenometer (Figs. 2, 3 and 4) is an instrument for reproducing

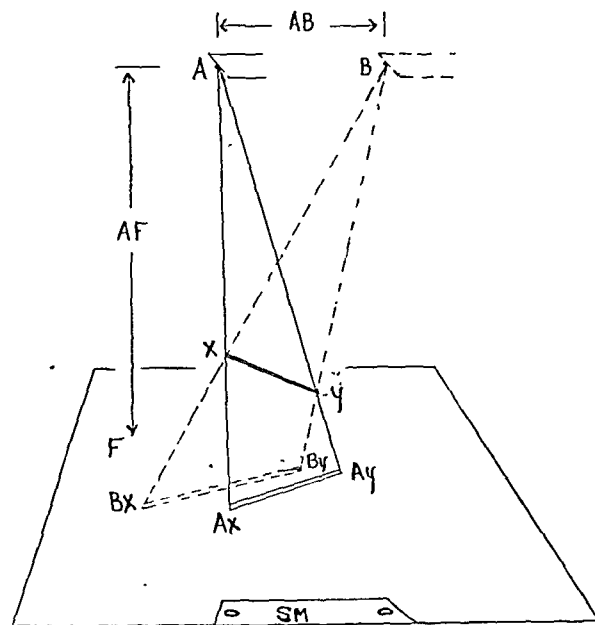


FIG. 1. Illustrating basic principle of stereoroentgenometry.

these conditions. A view box establishes the plane of the roentgenograms and provides illumination. An adjustable bar on the right fixes the roentgenograms in proper position and corresponds to the shadow  $SM$  (Fig. 1) of the special marker. Flexible wires, with automatically adjustable length and tension and means of terminal fixation, arise from points similar to the two positions of the target and represent the  $x$ -rays. Adjustable pointers fix in space the relative positions of the various unknown points. A special marker (Fig. 5) adapted to the tray of the Bucky diaphragm, casts a shadow upon the margin of the roentgenograms, which is of assistance in their exact superimposition and in the establishment of

their position on the view box. A metal cross marker of known dimensions is used for a check on the accuracy of the technic.

its application to other forms of measurement, especially pelvimetry. Although the author's stereoroentgenometer was de-

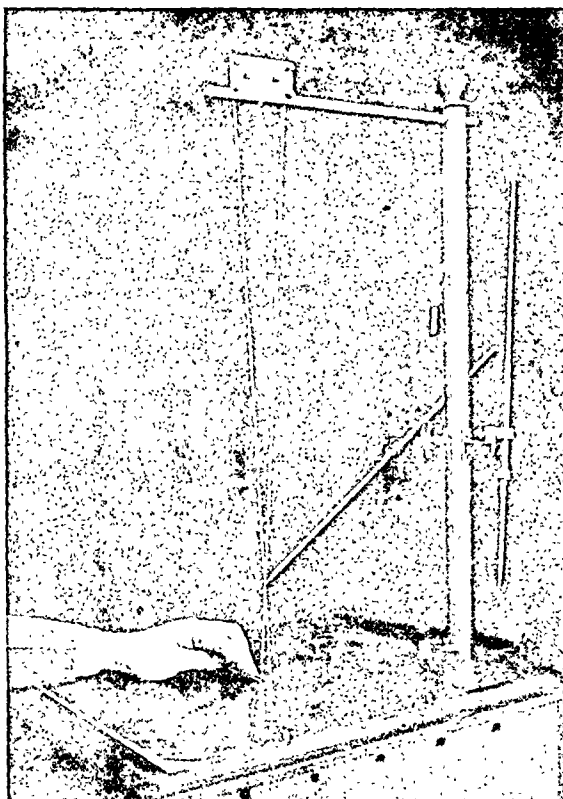


FIG. 2. The Stereoroentgenometer. Tips of compass rest upon points marked on promontory of sacrum.

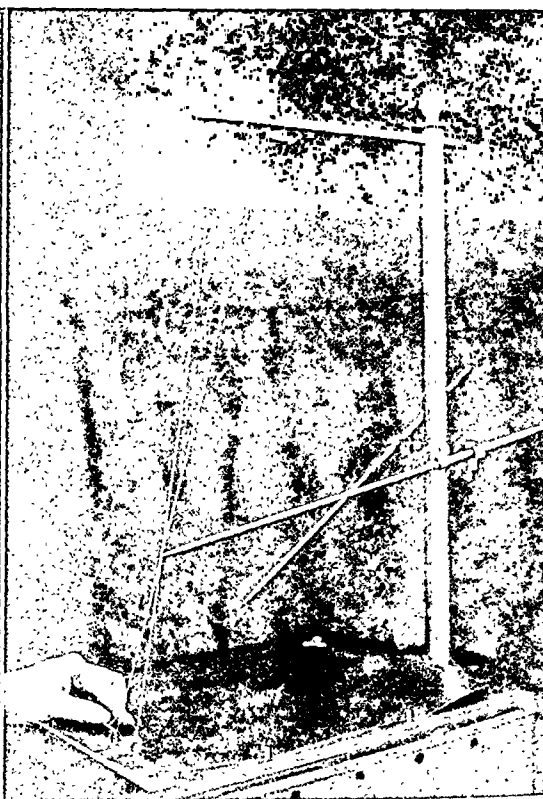


FIG. 3. Tips of compass resting on similar points on shadows of upper border of symphysis.

#### APPLICATION OF STEREOROENTGENOMETRY

Stereoroentgenometry is applicable to all those conditions wherein the knowledge of solid dimensions may be of value in diagnosis.

The principle is not a new one. Stereoroentgenograms are made use of in many of the various methods for foreign body localization. Chamberlain and Newell<sup>1</sup> have perhaps been most successful in calculating pelvic measurements from stereoroentgenograms. Their method is largely a mathematical one. In 1898, Sir James Mackenzie Davidson described a "cross thread method" for localization of foreign bodies. Again in his book<sup>2</sup> published in 1916 he reviewed his work and suggested

<sup>1</sup> Chamberlain, W. E., and Newell, R. R. Pelvimetry by means of the roentgen ray. *J. Roentgenol.*, 8: 272, 1921.

<sup>2</sup> Davidson, Sir J. Localization by X-Rays and Stereoscropy, N. Y., Hoeber, 1916.

veloped entirely independently from any knowledge of the work of Mackenzie Davidson, the instrument bears a family resemblance to the apparatus which he used and recommended so highly.

#### GENERAL ROENTGENOGRAPHIC TECHNIC

The Potter-Bucky table with tube stand attached is ideal for this work. When once a standard setting is established it can readily be duplicated.

1. Center the target of the tube over the center of the Bucky tray, with a target-film distance of exactly 25 inches.

2. Set the stereoscopic shift for  $1\frac{1}{4}$  inches each side of the center, or a total shift of  $2\frac{1}{2}$  inches. Use a longitudinal shift.

3. Place special marker in Bucky tray in appropriate notch (Fig. 5). For a  $14 \times 17$  inch film the inner edge of the marker is

exactly 6 inches from the center of the Bucky tray. For a  $10 \times 12$  inch film the inner border of the marker is 4 inches from

stereoscopic roentgenograms of a normal case, made two weeks before term. This is the most favorable time for examination

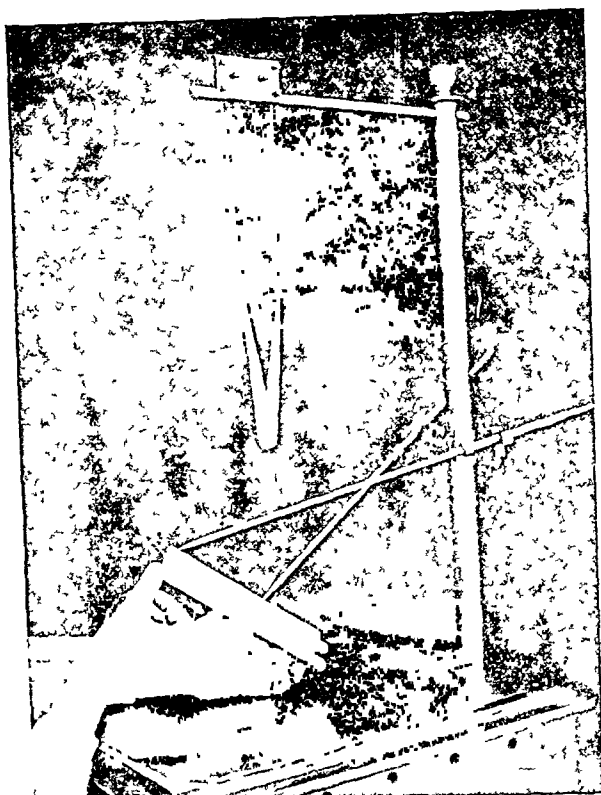


FIG. 4. Measuring distance between sacral promontory and symphysis.

the center. The marker may also be adjusted for other size of film and cassette.

4. Place the cassette in the center of the tray with its further edge beneath the marker. In this position the marker will project over the edge of the film one inch.

5. With a piece of adhesive fasten the cross marker of known dimensions on the patient in such a position that its shadow will be cast on the film.

6. Make stereoroentgenograms with exposure appropriate to the case. The exposure should be of such a density that the desired landmarks will just be clearly visible. If overexposed there will be some difficulty in seeing through both films when they are superimposed.

#### STEREOROENTGENOMETRY OF THE FEMALE PELVIS

Figure 6 is a tracing from a pair of

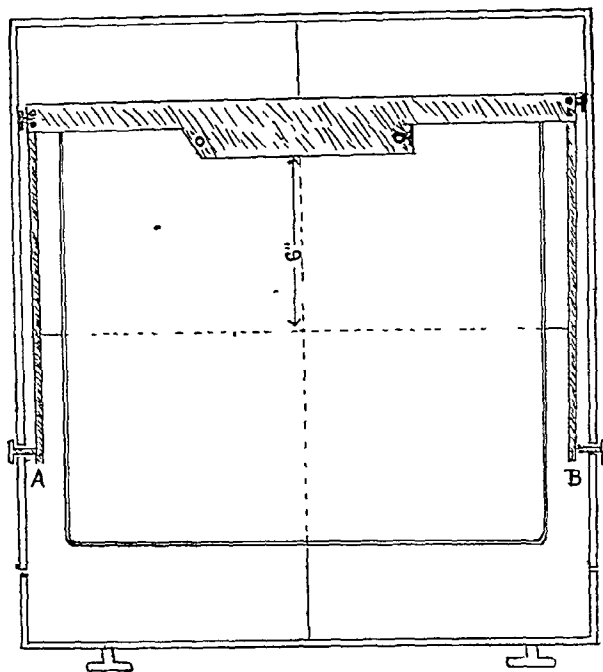


FIG. 5. Showing special marker adapted to tray of Brady Bucky diaphragm. The marker is hinged in notches A and B. Its back edge then rests upon cassette.

since most information can be gained. The points for measurement are marked. At the right of the pelvis is the shadow of the cross-shaped marker of known dimensions. This marker is used on all cases as a check on the accuracy of the technic. Its calculated dimensions, as compared with its actual, should check within a millimeter of accuracy.

In determining the dimensions of the pelvis and the fetal head (Figs. 8, 9 and 10), the diameters of the pelvis as given in the textbooks are ordinarily used. In the inlet I have used two additional measurements, which I have called the right conjugate and left conjugate. These diameters extend from the right and left sacroiliac synchondrosis to the symphysis pubis. They are used as an additional check on the anteroposterior diameter of the inlet. As a matter of interest the angle of the plane of the inlet is also calculated. Its



average is about 40 degrees with the horizontal, the patient being in a supine position.

stoscopic roentgenograms as described under "General Roentgenographic Technic." Have patient breath easily. Deep breathing,

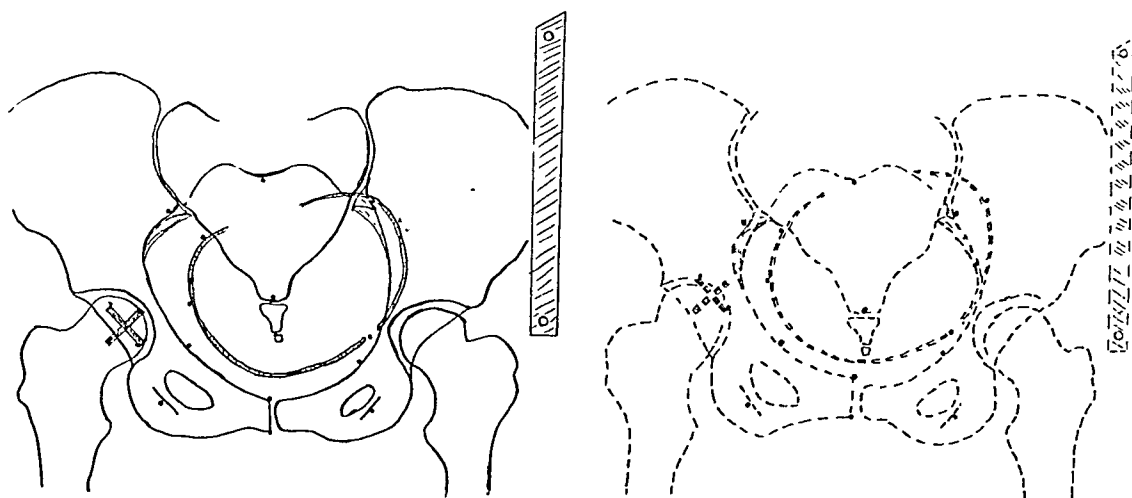


FIG. 6. Tracings from pair of stereoscopic roentgenograms showing points marked for measurement.

#### TECHNIC OF EXPOSURE FOR PELVIMETRY

1. Center the patient to a line just above an imaginary plane passing thru the anterior superior spines of the ilia.

2. Fasten the cross marker to the skin with adhesive near the right inguinal region.

or an attempt to hold the breath, will cause movement of the fetus.

#### TECHNIC FOR MARKING ROENTGENOGRAMS AND CALCULATING PELVIC DIMENSIONS

The recognition and the marking of the points on the roentgenograms from which

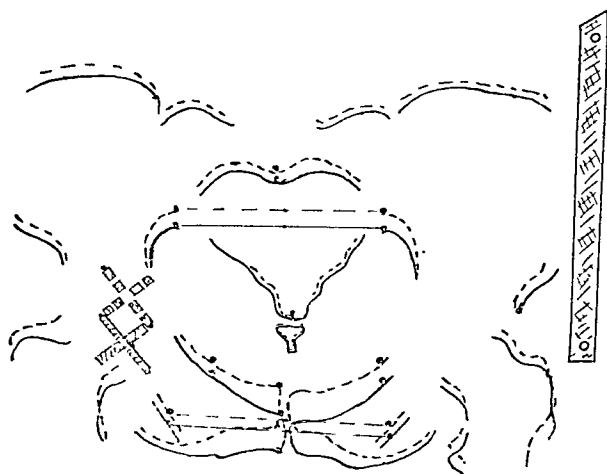


FIG. 7. Tracings of Figure 6 have been superimposed according to shadows of special marker on right. Points nearest film show least shift in shadows. Shadows of fetal head omitted.

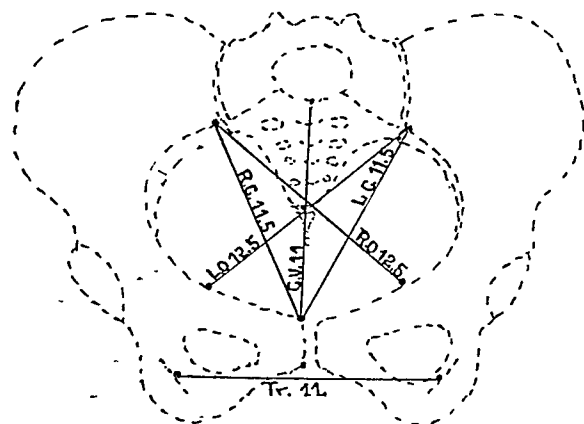


FIG. 8. Normal diameters of the pelvis. C.V., True conjugate, 11 cm. R.C., Right conjugate, 11.5 cm. L.C., Left conjugate, 11.5 cm. R.O., Right oblique, 12.5 cm. Tr., Transverse, 11 cm.

3. Use a fine focus tube, 25 inch target-film distance,  $2\frac{1}{2}$  inch longitudinal shift, 85 k.v.p., 150 to 200 ma. sec., for a case of pregnancy at term. Make stereo-

measurements are to be taken must be done with care. This is the only part of the entire operation in which the personal equation may cause variation in the results. The average normal diameters of the pelvis and fetal head are based on measure-

ments taken from points herein described. These points have been chosen because they represent these given in the textbooks

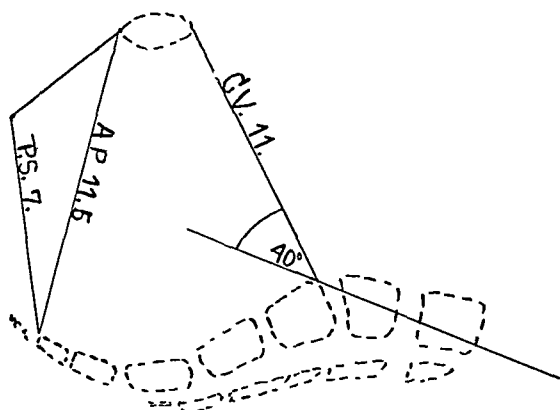


FIG. 9. A.P., Anteroposterior, 11.5 cm. P.S., Posterior sagittal, 7 cm. Angle of inlet, 40 degrees

on obstetrics. It is remarkable how nearly the diameters of the normal pelvis as calculated by stereoroentgenometry cor-

1. Place the roentgenograms on the stereoscope.
2. On one of the roentgenograms place

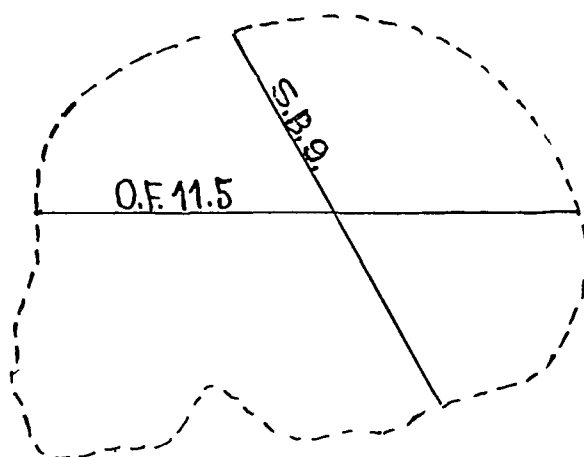


FIG. 10. Diameters of fetal head. Suboccipito-bregmatic, 9 cm. Occipito-frontal, 11.5 cm.

ink dots on the following anatomical points:

- a. The promontory of the sacrum.



FIG. 11. Normal pelvis at term. Angle of inlet, 43 degrees. True conjugate, 11 cm. Right conjugate, 11.5 cm. Left conjugate, 11.5 cm. Right oblique, 12.5 cm. Left oblique, 12.5 cm. Outlet. Transverse, 11 cm. Posterior sagittal, 7.5 cm. Fetal head. Suboccipito-bregmatic, 9 cm. Occipito-frontal, 11 cm.

respond with those taken directly from the normal dried pelvis.



FIG. 12. Case 32, Justo-minor type with head of average normal size. Delivery by cesarean section and size of unmodelled head checked. See text.

In term pregnancies, with long inlets, this may not be shown.

- b. The sacroliac synchondrosis, both sides, at the brim of the pelvis. Care must

be taken that these points are at the brim of the pelvis, and not at the border of the greater sciatic foramen.

and superimpose them, such that the inner border of the shadows of the special marker are at all times exactly super-



FIG. 13. Case 43. Justo-major type which developed persistent occiput-posterior position.



FIG. 14. Case 40. Kypho-chondrodystrophic type. See table for diameters.

c. The upper border of the pubic symphysis.

d. Arbitrary points on the brim of the pelvis near the normal anatomical location of the iliopectineal eminence, on both sides.

e. The lower border of the symphysis.

f. The inner border of the inferior surface of the body of the ischium. This will usually be visible as a white line about 1 inch in length. Take a point near the center of this line. Take similar point on opposite ischium.

g. The tip of the sacrum at its articulation with the coccyx.

h. If the fetal head is present, mark the sub-occiput, the occiput, the anterior fontanelle, and the frontal region. If the head has not engaged it will usually lie in such position that the shadow of the head is that of the sagittal plane.

i. Mark the tips of the cross bar of known dimensions.

3. Take the films from the stereoscope

impose and parallel during the marking of the points on the other film.

4. Shift the films, one over the other, in a longitudinal direction, until the shadows of the promontory of the sacrum are exactly superimposed. Perforate both films with a needle at the point previously marked with an ink dot.

5. Superimpose the shadows of the anterior surface of the first sacral segment. This automatically fixes the shift of the points on the brim of the pelvis at the sacroiliac synchondrosis. Perforate both films at the ink dots on the brim of the pelvis at the sacroiliac synchondrosis.

6. Superimpose the shadows of the pelvic brim at points marked on the iliopectineal eminence and perforate.

7. Superimpose the shadows of the upper boarder of the symphysis and perforate at the points marked.

8. Superimpose the shadows of the tip of the sacrum and perforate.

9. Superimpose shadows of the lower border of the symphysis and perforate.

10. Superimpose shadows of the inner

wires cross. This will be the actual location in space of the sacral promontory at the time the roentgenograms were made.



FIG. 15. Case 51. Contracted outlet with breech presentation.



FIG. 16. Case 55. Disproportion due to old fracture. Note moulding of head.

margins of the ischial tuberosities and perforate.

11. Superimpose the shadows of the fetal head and perforate at points marked on sub-occiput, occiput, anterior fontanelle, and frontal region.

12. Superimpose the shadows of the special marker (Fig. 7), punch out the holes at the ends of the shadow of the special marker, and place holes over the pegs of the bar on the right of the view box of the stereoroentgenometer.

13. With a ruler draw lines between the points marked on the sacroiliac synchondrosis; also between the points marked on the inner border of the ischial tuberosities (Fig. 7).

14. Take the compass in the left hand and cross the wires once (Fig. 2). Place the tips of the compass on the points marked on the shadows of the sacral promontory. With the right hand bring the tip of one of the pointers to the point at which the

15. With the left hand place the tips of the compass on the points marked on the upper border of the symphysis (Fig. 3). With the right hand bring the tip of the pointer to the point at which the wires cross. This will establish in space the actual position of the upper border of the symphysis.

16. Take the ruler and measure the distance between the tips of the pointers (Fig. 4). This will be the true conjugate.

In like manner determine the remaining diameters of the pelvis.

17. Place the tips of the compass near the mid points of the lines drawn between the points on the sacroiliac synchondrosis (Fig. 7). The point at which the wires cross will be the level of the posterior edge of the pelvic brim. Fix it with the tip of one of the pointers. Then place the tips of the compass on the upper border of the symphysis. The crossing of the wires will mark the upper border of the symphysis. The angle produced by a line through these

two points, with the horizontal, will be the angle of inclination of the pelvic inlet (Fig. 9).

time the roentgenologist studies a stereoscopic roentgenogram of the pelvis, whether for measurement or not, to



FIG. 17. Case 1. .38 caliber bullet in neck causing pressure symptoms on brachial plexus.



FIG. 18. Case 11. Bullet in left lung.

18. Place the tips of the compass near the mid points of the lines drawn between the ischial tuberosities (Fig. 7). Fix the point of the crossing of the wires with the pointer. Then locate the tip of the sacrum in space. The distance between these two points will be the posterior sagittal diameter (Fig. 9).

19. Determine the diameters of the fetal head from points marked.

20. Check the technic by calculating the diameter of the crossed metal marker.

I have purposely gone into minute detail in the above descriptions. The operation may seem rather formidable but really it should be a very simple procedure for the roentgenologist. In the beginning it may be well to take a dried pelvis and calculate its diameters. It will help in recognition of the anatomical points. The next step should be the calculation of the diameters of the pelvis on a suitable non-pregnant subject. It is well that every

identify the anatomical landmarks. Once the technic is acquired, all the desired diameters of the pelvis can be calculated in a period of ten minutes. The stereoscopic roentgenograms may be taken by the average competent x-ray technician, without assistance from the obstetrician or roentgenologist. The examination is free from any injury, and is not in any way embarrassing to the patient.

#### REPORT OF 50 SELECTED CASES

In Table I is a summary of 50 selected cases in which the diameters of the pelvis were determined. These cases have been selected from those referred by experienced obstetricians in private practice, and from those occurring in the Los Angeles General Hospital.

In this summary the cases are grouped as average normal, small or generally contracted, irregularly contracted, those with congenital dislocation of the hip, those in which a persistent occiput-posterior

TABLE I

FIFTY SELECTED CASES SHOWING VARIOUS TYPES OF FEMALE PELVIS AND THEIR CLINICAL MEASUREMENTS AS COMPARED WITH ROENTGENOLOGIC. ALSO, THE OUTCOME

## Average Normal

Case No.	1	2	3	4	5	6	7	8	9	10
Age .	28	23	25	28	31	28	25	26	24	28
Para.	1	1	1	1	1	1	1	1	1	1
I.S .	23.5	24.5	25	25	27	25	25	20	25	26
I.C..	28.5	27	27	27	29	27	28	24	27	28
Baud	17.5	18.5	22	20.5	20	20	20	17	18	20
Angl.	30	45	45	40	43	30	40	38	38	65
C.V	11.4	11.2	11.5	....	....	....	13	12.5	..	13
R.C.	11.2	11.5	12	12	13.5	11.5	12.7	13	12	13
L.C	11	11.2	11.5	11.7	13	12	12.7	12.2	11.7	13
R.O	12	12.5	12.7	13.5	15	12	13.2	12.5	12.5	13
L.O	12.5	12.7	12	12.5	14	12.5	13.5	12.3	12.8	13
A.P	11	11	12.5	12	....	12.5	11.7	13.7	11	14
Tran	11	11.5	12	12.5	11.5	11	11.5	11.2	11.0	12
P.S	7.2	6.2	8.5	8.5	8	8.5	6.1	8.5	6.5	8
Sum	18.2	17.7	20.5	21	19.5	19.5	17.6	19.7	17.5	20
S.B	....	8.7	10	....	9.5	8.8	9.5	8.8	9	9
O.F.	....	11	12	....	11.5	10.8	11.5	10.5	10.8	10.5
Lab	Av.	Av.	Av.	Av.	Av.	Av.	Av.	Av.	Av.	Av.

## Average Normal

Case No.	11	12	13	14	15	16	17	18	19	20
Age .	24	23	26	24	28	29	25	23	25	17
Para	1	1	1	2	4	7	5	4	1	1
I.S	26		23	26	20	23	25	25	26	24
I.C .	26		28	29	23	25	27	26	28	28
Baud	20		17	18.5	16	16.5	18	17	19	18
Angl	40	40	36	40	30	40	43	37	40	30
C.V	14	..	....	..	11.5	....	....	....	12	
R.C	13.2	12	12	12.2	11	11	13	13	12.2	12
L.C	12.5	12.5	11.5	12	11	11	12	12	11.5	12
R.O	13.7	13	13.5	12.6	12	12	13	12.7	12.8	13
L.O	12.5	13	12.5	13	12	12.5	12.6	13	12.8	12
A.P	13.5	13	12	11.3	10.4	10.5	12	10	11	12
Tran	11.2	10.5	11.2	11	13.3	11.3	11	11.2	10.5	11
P.S	8	7.5	7	7	7	6.8	7	6.6	6.7	6
Sum	19.2	18	18.2	18	20.3	18.1	18	17.8	17.2	18
Lab	Av.	Av.	17 Hr.	7 Hr.	15 Hr.	12 Hr.	16 Hr.	9 Hr.	11 Hr.	8
Wt.-Lb	....	....	6.6	7.7	6.5	9.7	7.7	6	9.3	7

## Small

Case No	25	26	27	28	29	30	31	32	33
Age	24	19	22	16	27	18	24	20	24
Para	1	1	1	1	1	1	1	1	1
I.S		22	24	22	26	22	27	21	21
I.C.		25	25	25	28	24	29	24	24
Baud		18	16	19	17	16.5	21	18	17
Angl	40	37	45	40	40	40	45	55	45
C.V	10.6	10.5	10.5	....	10.5	...	....	10.5	
R.C	10.3	10.7	10.7	10.8	10.7	10.5	10.7	11.5	9.5
L.C	10.6	10.2	10.2	10.2	10.3	10.7	11.0	11.2	10.5
R.O	11.5	11.0	11.0	12.3	12.0	11.5	11.5	12.7	10.0
L.O	11.7	11.3	12.0	11.7	11.5	11.0	12.0	12.2	11.0
A.P	10	11.3	10	11	11.5	10	12	9.5	10.5
Tran	10.5	9.8	9.5	10.2	11	11.5	10.6	10.7	11
P.S	5.5	6.1	6.8	6.2	7.5	5.7	6.8	6	6.5
Sum	16	15.9	16.3	16.4	18.5	17.2	17.4	16.7	17.5
S.B	9.5	...	....	....	....	....	9	9.8	
O.F	11.6	....	....	....	....	....	11.5	11.5	
Lab	Sec.	22 Hr.	45 Hr.	18 Hr.	19 Hr.	17 Hr.	8 Hr.	Sec.	20 Hr.
Wt.-Lb	7.2	4.3	6.1	7	7.7	6.1	8.6	7.3	5.7

TABLE I (Continued)

	Contracted							Cong. Hip	
Case No.....	34	35	36	37	38	39	40	41	42
Age.....	17	21	19	43	26	24	25	38	30
Para.....	1	1	1	1	1	1	1	4	7
I.S.....	21	22	24	26	26	23	19	25	22
I.C.....	23	26	26	28	29	25	25	27	26
Baud.....	16.5	16.5	17	18	19	18	19	19	18
An I.....	40	40	28	40	40	....	25	48	40
C.V.....	....	10.5	10.6	....	9	12	7.5	12.5	11.3
R.C.....	10.1	9.7	10.7	12	8.4	12	8.8	14.5	11.5
L.C.....	9.7	9.6	10.5	11.5	10	11	8.8	13.5	12
R.O.....	11	11.7	11.5	13.2	10.5	12.5	9.3	13.5	14
L.O.....	11	12	12	13.2	12	11	9.7	14	12.5
A.P.....	9.5	11	8.5	9.5	11	12.2	10.2	12	10.5
Tran.....	12	11.5	11.5	11.7	13	9.7	10	12	14
P.S.....	5.5	8	6.3	3.9	7.5	7	5.3	7.6	6.6
Sum.....	17.5	19.5	17.8	15.6	20.5	16.7	15.3	19.6	20.6
S.B.....	8.8	9	....	....	....	....	....	....	9.8
O.F.....	10.5	....	....	....	....	....	....	....	11.8
Lab.....	32 Hr.	13 Hr.	49 Hr.	36 Hr.	For.	For.	Ster.	6 Hr.	9 Hr.
Wt.....	5.7	5.1	7.2	4.9	4.3	6.8	....	7.6	7.4

## Occiput Posterior

## Breech

Case No.....	43	44	45	46	47	48	49	50	51
Age.....	24	....	22	34	....	....	28	22	17
Para.....	1	1	1	1	1	1	1	1	1
I.S.....	23	....	28	23	....	....	22	25	23
I.C.....	27	....	30	27	....	....	24	27	27
Baud.....	20	....	18	19	....	....	20	....	16.5
Angl.....	40	45	40	37	43	50	50	23	45
C.V.....	14	12.3	13	12.5	12	12.5	14.5	11.5	....
R.C.....	14	12	12.2	12.2	11.7	13	15	12	11.5
L.C.....	13.5	12	13.5	12.5	12	13.2	12.5	11.5	12.5
R.O.....	15	12.5	12.7	12.8	12.5	12.5	15	12.7	12.3
L.O.....	14.5	13.2	14	13.3	12.7	13	11.3	12.5	13
A.P.....	12.2	14	11	11.8	12.3	11.5	....	12	10.5
Tran.....	12.2	14	11	11.8	10.5	9.5	12	13	9
P.S.....	8	9	7.5	8	7.5	6.5	....	6.4	6.4
Sum.....	20.5	19	19.5	20	18	16	....	19.4	15.4
S.B.....	9.5	9.8	....	....	....	....	9.5	....	....
O.F.....	11.2	10.8	....	....	....	....	....	....	....
Lab.....	V. & E.	V. & E.	For.	For.	Dif.	Sec.	Dif.	8 Hr.	....
Wt.....	6.4	....	6.2	7.4	....	....	....	7	....

## Fracture

## Hydrocephalus

Case No.....	52	53	54	55	56
Age.....	....	....	25	37	....
Para.....	1	1	1	2	3
I.S.....	....	....	23	22.5	....
I.C.....	....	....	25	27	....
Baud.....	....	....	20	19.5	....
Angl.....	50	35	40	50	35
C.V.....	14.7	12.7	....	11.8	13.5
R.C.....	14	13.1	13.5	10.8	13.2
L.C.....	13	12.5	11.3	11.4	13
R.O.....	14.7	13.4	13.5	9.6	14
L.O.....	13.3	12.5	11.5	11.9	13.5
A.P.....	13	12.5	14	11.3	12.7
Tran.....	10.7	11.5	10.5	9.8	12.5
P.S.....	7	7.5	7.3	6.5	7.5
Sum.....	17.7	19	17.8	16.3	20
S.B.....	....	....	....	....	15
O.F.....	....	....	....	....	16.7
Lab.....	....	....	Sec.	For.	Cran.

position developed, those with contracture due to fracture, and one case in which the disproportion was due to a hydrocephalus.

equals or exceeds the suboccipito-bregmatic diameter of the fetal head plus 2 cm. The sum of the transverse and posterior



FIG. 19. Case III. Bullet in left hip showing crossed marker on skin surface directly over foreign body.



FIG. 20. Case IV. Stone in right kidney mistaken for gallstone.

An attempt has been made to correlate the available clinical data with the roentgenologic and with what happened at labor. I have included the external pelvic measurements as determined clinically. I could not get enough exact data as to internal measurements, or as to measurements of the outlet to warrant their inclusion here. It seems that these diameters, if taken at all, are a judgment based on the length of the palpating fingers and the width of the fist. Then follows in the table the pelvic dimensions as determined roentgenologically. The term "sum," refers to the sum of the transverse and posterior sagittal diameters of the outlet. In those cases with prolonged labor, only those have been included which were definitely due to abnormal resistance in the bony canal.

Cases 1 to 20 are representative of the average normal. It is of interest to note that the antero-posterior diameter of the inlet

sagittal diameters of the outlet equals or exceeds the suboccipito-bregmatic diameter of the head times 2 cm. This proportion can not be stated to be absolute but it does give a fair working basis upon which conclusions may be based as to disproportion between the fetal head and maternal pelvis.

Cases 25 to 33 are representative of the borderline or generally contracted type. Case 31 was somewhat of a surprise in that the cooperation of the patient and the ability of the head to mould proved to be the unknown factors. Even then the period of descent was relatively long as compared with the total period of labor.

Case 32 (Fig. 12) gave opportunity to check the diameters of an unmoulded head following delivery by cesarean section. A few hours before delivery the diameters of the fetal head as determined by stereoroentgenometry were: suboccipito-breg-



matic 9.8 cm., occipito-frontal 11.5 cm. Twelve hours following delivery the diameters of the head as measured directly were, suboccipito-bregmatic 9.8 cm.; occipito-frontal 12 cm.

Cases 34 to 40 represent irregular types of contraction. Case 40 (Fig. 14) is a markedly contracted kypho-chondrodystrophic type.

Cases 41 to 42 have congenital dislocation of the hip without pelvic deformity, none, at least, to the extent of producing dystocia.

Cases 43 to 46 developed persistent occiput-posterior positions. The tendency in all of this group is a relatively or absolutely large pelvis as compared with the size of the fetal head. Case 43 (Fig. 13) is typical of the justo-major type of pelvis. The angle of the inlet in all of these cases compares favorably with the average normal.

Cases 47 to 50 all presented by breech. All of these cases show some abnormality. Cases 47, 48 and 51 (Fig. 15) tend toward the funnel type. Case 49 has an oblique contracture of the inlet. Case 50 has an angle of 23 degrees of the pelvic inlet.

Cases 52 to 55 are representative of deformity due to fracture. This was of medico-legal importance in Cases 52 and 53. In both of these cases we could say with assurance that there was no deformity sufficient to interfere with the birth of a normal-sized fetal head. Case 55 (Fig. 16) had 3 cm. shortening of the right oblique diameter. In spite of this the head engaged and was delivered with instruments. The head was greatly moulded.

Case 56 is one of hydrocephalus. The diameters of the head as calculated were 15 cm. suboccipito-bregmatic, and 16.7 cm. occipito-frontal.

Incidentally there have occurred during the collection of this series one case of anencephaly and several cases of multiple pregnancy.

#### SUMMARY

Stereoroentgenometry as applied to pelvimetry offers a practical roentgenologic

method for accurate calculation of all the internal diameters of the maternal pelvis as well as the essential diameters of the fetal head. The examination also offers incidental information as to the position and presentation of the fetus as well as positive information as to the presence of a fetal monster or a multiple pregnancy.

#### STEREOROENTGENOMETRY FOR THE LOCALIZATION OF FOREIGN BODIES

Stereoroentgenometry is readily applicable to the localization of foreign bodies.

#### Technic

1. Fluoroscope the patient and at a point directly over the foreign body place an indellible skin mark.

2. Fasten, with adhesive, the crossed metal marker of known dimensions to the skin at the point marked.

3. Make stereoscopic roentgenograms as described under "General Technic."

4. Place the stereoroentgenograms in the stereoscope and mark the points from which measurements are to be taken, as described under pelvimetry. Place the roentgenograms on the stereoroentgenometer for measurement.

5. Determine the size of the foreign body. If it should be an undeformed bullet, its caliber will be its diameter in millimeters times four; e.g., a bullet 9.5 mm. in diameter will be a .38 caliber bullet.

6. Determine its depth with relation to the skin surface, as shown by the crossed metal marker.

7. Determine its location with relation to surrounding anatomical landmarks.

The following representative cases occurring in The Los Angeles General Hospital will be illustrative.

CASE 1. (Fig. 17). X-ray Report: Slightly deformed bullet in the soft tissues of the neck. Its diameter at the base is 9.5 mm. Its location is 1.5 cm. anterior to the tip of the left transverse process of the 7th cervical vertebra.

Operation by Dr. Carl Rand: A somewhat deformed .38 caliber bullet was readily located in the position described.

CASE II (Fig. 18). *X-ray Report*: An odd-shaped bullet in the lower-left thorax. It is 3.5 cm. in length. It lies 7 cm. posterior to the lower border of the 4th rib, 10 cm. anterior to the lower border of the 8th rib, and 3 cm. to the midline of the 6th rib in the midaxillary line. Fluoroscopically it lies just above the level of the diaphragm.

Operation by Dr. H. E. Schiffbauer: A portion of the sixth rib in the axillary region was resected, and the thorax opened. The bullet was found imbedded beneath the visceral pleura of the lower surface of the lung in the approximate location described. Its length was 3.5 cm.

CASE III (Fig. 19). *X-ray Report*: Bullet in left hip. It is 9.5 mm. in diameter at its base. It lies in an excavation in the upper surface of the neck of the femur at a point 2 cm. to the right of the upper and anterior angle of the greater trochanter.

Operation: The surgeon made a one-inch incision at the level of the upper border of the greater trochanter. By blunt dissection and the sense of touch, he then attempted to locate and remove the bullet. After an hour of discouragement he stated that our localization was all wrong; that he had thoroughly explored the area described and had found nothing. We suggested that possibly the bullet had been dislodged from its location during the blind search. The wound was closed. Re-examination the next day revealed the bullet in the soft tissues below the acetabulum.

During the past year we have had many cases for localization of foreign bodies of various description. The results have been uniformly excellent when the following rules were observed.

1. The removal of a foreign body is in many cases a major surgical procedure. A general anesthetic is usually required and wide exposure is necessary.

2. There must be absolute cooperation between the surgeon and roentgenologist. The roentgenologist must first have well in mind the location of the foreign body. He should be present at the operation and

guide the surgeon in his search. When failure is experienced in the removal of a foreign body, that failure cannot be charged to the method of localization.

#### STEREOROENTGENOMETRY FOR THE DIFFERENTIAL DIAGNOSIS OF KIDNEY AND GALL-BLADDER CALCULI

CASE IV (Fig. 20). A clinical diagnosis of probable gall-bladder disease.

*X-ray Report*: Cholecystograms show a non-functioning gall bladder. There is an oval-shaped shadow made up of concentric rings near the lower border of the liver and superimposed over the upper pole of the right kidney. This shadow, when localized, is found to lie in the plane of the kidney. Conclusions: pathological gall bladder. Single kidney stone.

It was suggested that this report might be criticized for even considering that the shadow might be due to a stone in the right kidney. However, after removing a gall bladder filled with stones, re-examination revealed the stone in the kidney, unmoved by the operation.

#### CONCLUSIONS

Stereoroentgenometry is a process for determining the solid dimensions of a radio-opaque object from its stereoscopic roentgenograms.

It is a practical procedure with which every roentgenologist should be familiar. It provides a ready method of measurement which may be applied to all those conditions wherein the knowledge of solid dimensions is an aid to exact diagnosis. A report of a foreign body is not complete without giving its dimensions and its location with relation to surrounding anatomical landmarks. A report of deformity of the female pelvis should include exact dimensions as to the extent of that deformity.

The stereoroentgenometer is the roentgenologist's "measuring stick."



# VALUE OF RADIUM IN THE TREATMENT OF MALIGNANT GROWTHS OF THE FACE\*

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PROBABLY the most common malignant lesion of the face is the rodent ulcer or basal-celled carcinoma. This lesion appears most frequently above a line drawn from the corner of the mouth to the tip of the ear. Contrary to the usual principle that a slow growing benign lesion is often most radioresistant, rodent ulcer seems to be pretty generally radiosensitive. The lesion is often readily diagnosed on account of its slow growth, rolled edges, crusted or depressed central portion, and induration. Lesions less than 3 mm. in thickness yield readily to relatively small doses of unscreened radium, ordinarily in the proportion of 10 to 15 mg. hr. per square centimeter. The treatment is simple and painless (which is acceptable to the patient), ordinarily with excellent cosmetic results though the end result may be achieved only after a period of about six weeks. Recurrences are not uncommon, but a second or even a third carefully planned radium treatment eliminates the lesion in about 80 per cent of the cases.

Squamous-celled, sometimes called prickle-celled, carcinoma of the face differs from basal-celled lesions in that it is less common, begins slightly below the epithelium, grows more rapidly, may ulcerate later, and not infrequently metastasizes. In spite of its more rapid growth, the lesion is ordinarily more radioresistant than the slow growing basal-celled epithelioma. The common sites for this lesion are the lip, the ear, the nose, and not infrequently the eyelid. In ordinary instances the surface application of unscreened radium can not be depended upon for cure except in lesions less than 3 mm. in thickness. Even in these superficial lesions, it is better to employ a dosage of 15 to 20 mg. hr. per square centimeter. Ordinarily it is

necessary to use some form of interstitial radiation in the form of needles or gold radon implants within the mass in addition to 40 to 60 mg. hr. per square centimeter of gamma rays at 0.5 to 1 cm. distance. Lesions not yielding readily to the first or second application should have careful consideration as regards surgical removal. Other mechanical methods besides excision by scalpel are to be considered and may be classified as surgical measures.

Lesions of either the basal or squamous-celled type which have reached some size require heavier dosage in the form of external, contact and interstitial radiation, sufficient for complete elimination. From 100 to 140 mg. hr. or mc. hrs. per cubic centimeter of involved tissue is an average recommendable dose for interstitial treatment, with reinforcement by gamma rays at a distance.

Lesions of the glabrous skin away from the nose, mouth, eye, or ear are easy of access for treatment and yield correspondingly good results. Lesions located on the eyelids or at either canthi may frequently be eliminated with unscreened contact radiation, though the implantation of radon seeds does much to insure satisfactory results. Lesions involving the nose or ears to such an extent that the cartilage is involved require mechanical removal. Superficial lesions not involving the cartilage often yield readily to vigorous surface radium treatment.

The surgical removal of malignancies of the skin can often be accomplished readily. Most failures are due to inadequately wide excision. Too wide an excision results in less desirable cosmetic results. Many of the lesions of the face are so located that surgical excision with proper technic is not possible or is exceedingly difficult.

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These lesions merit the consideration of radium therapy for their complete elimination. Other measures such as electrocoagulation with curettage are not infrequently used in a satisfactory manner but always there is the risk that the lesion is squamous-celled and that the trauma of curettage may result in recurrence with a remote possibility of earlier dissemination. Roentgen-ray therapy following surgical excision or coagulation and curettage is used with success in some clinics. With this technic much depends upon the experience and skill of the operators.

One might say, in general, that the treatment of skin malignancies of the face, can well be handled with radium. The percentage

of permanent cures is higher in the larger radium clinics than is obtained by any other methods anywhere. Technic, dosage, and results are frequently reported from these various radium centers, so that the availability of the method to the general medical profession is rapidly increasing. While the results obtained from the surgical treatment do not differ greatly from those obtained by radiation, the simplicity of treatment and technic, the painlessness, the absence of operative procedure, and the superior cosmetic results should induce the profession to explore and make use of, to the utmost, the radium treatment of superficial malignancies of the face.



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## EDITORIALS

### SURGICAL BABBITTS

#### A GROWING ABUSE

A MAN is known by his associates. American Surgery is known by the men who visit foreign clinics as representative of surgery in the United States. On the other side of the water they are forming a negative opinion of our value.

This is because it has become a fad for large groups of American physicians to descend, *en masse*, on well-known foreign clinics. These groups are composed not of well-trained men in the various surgical specialties, but of very mediocre general practitioners off on a holiday and sight-seeing.

We say "very mediocre practitioners" with intent. Often they are men not even outstanding in their home communities. They have done no studying since graduation from medical school, they read almost nothing, neither do they do any

research, add to the literature, visit home clinics or take postgraduate courses. They enjoy large practices or have made a fortune in real estate or the market. They yearn for travel, visits to foreign places, the sights offered by the show places of the world.

Enterprising members of the profession of the go-getter type organize clubs, groups, societies, much on the style offered by any well known travel agency, to visit foreign countries and see "all the clinics." Thirty to a hundred medical Babbitts, who have no idea of what it is all about and care less, "sign up" and in a gay mood depart for distant shores.

Early in the game they were well received. They were entertained and lionized. And then, in many instances, the workers in the foreign clinics woke up to actual facts. They discovered their honored

guests were in a mental fog concerning the work at hand, that they did not know the fundamentals involved, and cared not a hoot about the coarse or fine points under discussion. They were there for a good time. The visit to a medical center was just a line in the itinerary. Herdlike they would descend on a place and overrun it, strain their necks to see all, and were mainly interested in taking moving pictures of everything: the operators, the nurses in the "queer" looking uniforms, Bill from the home town, Jack sitting down in the front row, the anesthetist, the fellow in front, the gang in the back, the outside of the building, the corridors—(wait until we get home and spring these on the boys!)—or else write in little books voluminous notes of their adventures with which to regale the folks on their return.

We know of a hospital resident sent abroad a year to study. He relates that one day the "professor" of a well-known and popular foreign clinic was informed that a medical travel club, for the third or fifth consecutive season, would honor the place on the morrow. Sending for the American resident the professor said, "Take these visiting gentlemen to the Lake and see that they have a jolly time. I'm too busy to be bothered with them."

The Lake referred to is a place built along the lines of our own Coney Island.

We would not infer that all visiting groups of physicians and surgeons are the cause of this abuse. Far from it. Headed by nationally and internationally known surgeons such groups are composed, for the most part, of men who "know their stuff" and are eager to add to the sum of their knowledge. The foreign head of a clinic is acquainted with most of these men, and the students they send to him for study, and are glad to welcome them and be their host. This type of travel club is doing no end of good in fostering cordial scientific relations between our country and the countries abroad.

These Babbitts we have in mind do not come from only the small places; the large cities send more than their quota. They are herded into groups by the small-time imitator of the nationally known men, and feel there is glory in quantity. Let these groups devote their time to the Eiffel Tower, the Tower of London, the night clubs of Paris, and the world's famous restaurants. In this way they will give the real surgical workers a chance.

Let us take a hint from well-founded reports that come to us from abroad and put an end to this abuse.

T. S. W.



## SURGEONS AND RADIOLOGISTS

**D**URING the world war the "liaison officer" came to be well known as the individual who served to correlate the activities of different organizations, especially units of different allied armies. The publisher and the editor have long entertained the sentiment that it would be very desirable to have a liaison organ or organization between surgeons and radiologists. The writer, to whom has come the honor of editing this

section on radiology, has, especially during the last ten years, had numerous opportunities for serving as a sort of liaison officer between surgical and radiological groups.

It therefore seems opportune at this time to establish a section on radiology in this journal. Articles of a highly technical nature relating to radiology naturally find their publication in the journals devoted entirely to radiological interests, and it is not intended that the pages of this

section shall be devoted to such. Rather, it is the desire to devote our space to papers and case reports of a practical surgical nature or of special interest to general practitioners of surgery. This section should therefore appeal to the radiologist who derives a large part of his referred work from surgeons and who should seek to understand as fully as possible the surgical application of his radiological findings. It should appeal to the surgeon because of his inevitable interest in, and his dependence upon, the radiological findings.

In the months to come the editor of this section will endeavor to present in these pages not only suitable contributions but also editorials of an intensely practical nature designed to emphasize many valuable points in the radiology of surgery.

JAMES T. CASE.

## SOCIETY NOTICES

At the meeting of the American Urological Association held in Seattle last June Mr. Reinhold Wappler was elected an associate member. He is well known throughout the profession in the United States. He was the founder of the Wappler Electric Company and at the present time he is president of the American Cystoscope Makers, Inc.

The American Association for the Study of Goiter will hold its annual meeting in Seattle, Washington, on July 10, 11 and 12 of this year. The headquarters will be at the Olympic Hotel where two days' session will be held and the meeting of the third day will be at Paradise Inn, Mount Rainier. Arrangements for the meeting are in charge of Dr. J. Tate Mason, of Seattle, Vice-president of the Association.

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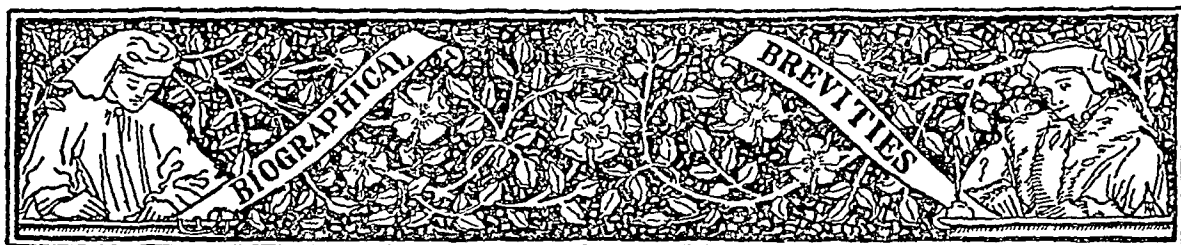
ABRAHAM COLLES

[1773-1843]

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BIOGRAPHICAL BREVITIES  
"Colles' Fracture"

*The American Journal of Surgery*  
N. S. Vol. viii, January, 1930



## "COLLES' FRACTURE"

**A**BRAMHAM COLLES was born in 1773. His early life was uneventful and he did nothing to cause one to forecast a brilliant maturity. He had the usual academic and professional education of his time.

For thirty-two years (1804-36) he was professor at the University of Dublin. He far outshone his colleagues. He comes down to us labelled "the leading Irish surgeon of his day."

It is recorded that he tied the subclavian artery twice. He reported these cases in the *Edinburgh Medical and Surgical Journal* in 1815. This was a giant feat in the days before anesthesia. He was the first surgeon to tie the subclavian artery within the scaleni.

Although no one has been able to verify

the fact, legend tells us Colles was the first man to successfully tie the innominate artery.

He was a fairly profuse writer on anatomical and surgical topics. In 1811 he wrote a treatise on surgical anatomy. Later in life he did a work on surgery. However, his bid to fame rests on his original description of fracture of the carpal end of the radius or "Colles' fracture." He published an account of this in 1814.

To many he is known for his "Practical Observations on the Venereal Disease" (1837), in which he expounded Colles' law, "relating to the supposed immunity which a healthy mother acquires in bearing a syphilitic child."

Colles died at the Biblical age of seventy years, in 1843.





[From Fernelius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

## ON THE ALLEGED PENETRATION OF THE HUMAN URETHRA BY AN AMAZONIAN CATFISH CALLED CANDIRU

WITH A REVIEW OF THE ALLIED HABITS OF OTHER  
MEMBERS OF THE FAMILY PYGIDIIDAE\*

PART I

E. W. GUDGER, PH.D.

NEW YORK

### INTRODUCTION

THROUGHOUT the Amazon valley for more than a hundred years the tale has been widely told of a fish that has the uncanny habit of penetrating the urethra of men and women bathers, particularly if they should pass urine while in the water. This evil habit has been ascribed to various fishes large and small of the catfish family, but it seems not improbable that mixed with these accounts are exploits attributable to a voracious Characinid fish called Piranha.

For many years I have been collecting and filing away accounts of this alleged habit of the candirú.<sup>1</sup> My editorship of

volume III of the *Bibliography of Fishes*<sup>1</sup> and of its continuation card catalogue, has given me opportunity to go still deeper into the literature of this subject.

In the meantime Dr. C. H. Eigenmann, that distinguished student of South American fishes, had already (1918 a and b) brought together a considerable number of these accounts. However, as I have additional ones (and what are believed to be all ever published) together with a number of first-hand accounts, and since from this large amount of data I have been able to work out what is probably the correct explanation of this long alleged phenomenon, it seems worth while to bring all this data together and to set forth the explanation of this most extraordinary phenomenon for presentation to scientists and especially to medical men. The accounts will now be set forth chronologically, and then an analysis will be

<sup>1</sup> An effort has been made to ascertain the origin and meaning of the word *Candirú* (also spelled *Kandiroo*) but to little purpose. C. F. von Martius in his "*Wörter-sammlung Brasilianischer Sprachen*" (Leipzig, 1867) on p. 37 says that it is a Tupi word, and on p. 442 gives *Canderú* as a variant spelling. As will be seen later, the fish also bears (on the Amazon headwaters) the Spanish name *Canero* or *Carnero*: flesheater.

<sup>1</sup> Published 1923 by the American Museum.

\* Submitted for publication October 31, 1929.

attempted in the effort to get at the truth.

#### THE PUBLISHED CANDIRÚ STORIES

The first account comes from Martius who in his preface to Spix and Agassiz's "Selecta Genera" (1829) says:

Concerning another fish which is also dangerous to man, I ought to add some things. The Brazilians call this fish *Candirú*, the Spaniards living in the province of Maynas [Peru] name it *Canero*. By a singular instinct it is incited to enter the excretory openings of the human body when it can get at these parts in those who are bathing in the river. With great violence it forces its way in and desiring to eat the flesh it unfortunately brings danger to human life. These little fishes are strangely attracted by the odor of urine and consequently the dwellers in these parts when about to go into the river Amazon, in whose bays this pest abounds, constrict the prepuce with a string and refrain from urinating. This fish belongs to *Cetopsis*, a genus which we have described, but I do not know whether these pests are the younger individuals of the species described (*C. candirú* and *C. coecutiens*), or whether they are individuals of a third species of smaller fishes endowed also by nature with this cruel instinct.

Martius in the third volume of Spix and Martius' "Reise in Brasilien" (1831) refers to this matter, repeats the account, and adds to it as follows, localizing the phenomenon at Pará.

Not seldom did we hear in Pará also of the dangers which beset those bathing in the river due to a little fish called Candirú. The things told of this sound so unusual that I myself am almost afraid to relate them here. *Cetopsis* is a genus belonging to the Salmons [Characins] . . . A species of this genus, the Candirú of the aborigines, a little fish of the length and thickness of one's finger—whether the younger individuals of one or both of the species described by us (*Cetopsis candirú* or *C. coecutiens*) or of a third and as yet undescribed species, I unfortunately cannot say since my specimens of this last have been lost—has the habit of entering with great impetuosity and rapidity into the external openings of the human body. It thus brings

about a most painful and dangerous accident since it stretches out its fins and cannot be gotten out save with great difficulty. The odor of man's excretions appears to attract the little fish, and the Indians therefore advise that while in bathing none of this excretion be passed and that this particular organ be covered carefully. The Indians who served me as boatmen corroborated their account of this singular habit by relating several instances. However, as we had observed that the belief in the improbable and the exceptional as well as a ridiculous fear of ghosts constituted a peculiar trait in their characters, their accounts did not convince us until through our friend Dr. Lacerda we as eyewitnesses were made cognizant of the truth of the matter.

The above is translated literally, but is at best ambiguous. It would seem to indicate that Dr. Lacerda personally showed to Spix and Martius an actual case of this phenomenon. This seems improbable for had he done so Martius would undoubtedly have described it differently. What seems to me to be the thought involved is that Dr. Lacerda in the course of his medical practice had had such a case and that he had so clearly described it that they understood it as well as if they had been eyewitnesses. At any rate it would seem that Martius gave full credence to the report.

We next hear of the candirú in the writings of Poeppig (1836). In a footnote to a four-page paragraph on the insect plagues of Maynas, Peru, Poeppig says of a plant called *Xagua* used in warding off insects that:

The fresh juice of the *Xagua* is rightfully claimed to be the surest means of killing and getting rid of these two-inch long little fishes which slip into the outer openings of the bodies of careless [unprotected] bathers and bring about the most dreadful accidents. In Maynas as *Canero* and on the Solimoes [Amazon] as *Candirú*, it is known and feared. The attack of such a fish in such a manner is such an extraordinary thing that one can scarcely believe it. Likewise Herr von Martius (Reise, III, 955) admits being very skeptical of this tale, which he had had from the Indians, until

the well-known naturalist and physician of Pará, Dr. Lacerda, had explained its foundation in truth. In Yurimaguas I myself have been an eyewitness of such a case. An Indian woman, after the penetration by a *Canero* into the vagina, suffered such frightful pain and loss of blood that she was given up to die. However, after both internal and external applications of *Xagua*, the little fish was gotten out and the woman came through alive.

The great superstition of the Indians hindered me in collecting this fish. The only *Caneros* I have are the ones collected in numbers in Yurimaguas. The stage of development of these fishes, though scarcely two inches long, is such that they cannot be taken for young individuals. Unfortunately they spoiled in the weak spirits of the country. As far as memory goes the figures of *Cetopsis* (Martius, Pisces, tab. 10 f. 1, 2) do not appear to agree with the *Canero* of Maynas.

It should be noted just here that Poeppig's journey (1827-1832) followed just ten years after that of Spix and Martius (1817-1820), that he frequently refers to them, that he probably knew Dr. Lacerda in Pará, and, such was his standing as a zoologist, that in 1845 he was made professor of zoology in Leipzig.

In the *Annals and Magazine of Natural History* for 1840, and in *Froriep's Notizen* for 1841, is found the following quotations credited from "Schomburgk's mss.:"

While at San Joaquim, on the Rio Breneo [Branco? a tributary of the Rio Negro] I was frequently warned by the inhabitants to be cautious while bathing of a small fish called *Cancliru*, which they said entered the urethra and rectum, chiefly if one while in the water should satisfy nature; that the greatest difficulty attended the extraction of this little fish, which often caused most dangerous inflammation and even death. Although these accounts were given me by persons whom I had no reason to disbelieve, I could not find any one who had been an eye-witness of such an uncommon event, and I began to doubt its possibility . . . The fish was described to me to be about half an inch in length and gregarious.

This is presumably Robert H. Schomburgk, but careful examination of his

"Fishes of British Guiana" brings to light no reference to our fish, although other fishes from the Rio Branco are described. Examination of the works of Richard Schomburgk also give no data.

Our next author for citation is Castelnau (1855) who first correctly gives our ravenous fish a scientific name and standing in the family Pygidiidae. Under the nomenclature of *Trichomycterus pusillus*, he describes a little siluroid fish (full grown specimens of which were 9 cm. (3.6 in.) long as a new species from the rivers Araguay and Amazon. Of its alleged habits he gives the following amazing account which will be discussed later.

This species is, on the part of the fishermen of the Araguay, the object of a most singular prejudice. They claim that it is very dangerous to urinate into the river, because, they allege, this little animal launches itself out of the water and penetrates the urethra by ascending the length of the liquid column.

When Reinhardt (1859) discovered a small, slender catfish provided with retrose gill-cover spines, living in the gill-cavities of a huge silurid of another family, he named it *Stegophilus insidiosus*. From its habits he sought to connect his fish with the candirú. His full account will be given later, but just here reference only to that part relating to the candirú will be made. He says that the story that the candirú penetrates the urethra or rectum of bathers sounds like a fairy tale, but that there are several reliable accounts of its activities from Spix and Martius, from Schomburgk, and from Castelnau. Then he continues:

That these dangerous small fishes should have the special instinct to make their way into the above mentioned openings in the bodies of bathers will not be believed by many; and it is also evident that only very few fishes could gratify the instinct if they had it; but it is less unnatural that a fish with the mode of living of *Stegophilus* should by accident or mistake act thus. Whether it is exactly the same fish which in different regions has gained such a bad reputation is a question that cannot

be decided at the present time; but it is probably in any case a closely related species; and it is very interesting that, if so, even if it is not a *Stegophilus*, it must be one closely related to it.

Günther (1864) speaking of the fishes belonging to the genus *Vandellia* says: "These fishes are accused of entering and ascending the urethra of persons while bathing, causing inflammation and sometimes death. Although this story is repeated by most travellers in the Brazils none of them has ever seen a case confirmatory of it." This statement is repeated for both *Stegophilus* and *Vandellia* by Günther in 1880 with the added allegation that it lacks confirmation for both.

Marcoy (1869) gives a general account of the fishes of the upper Amazon, and of the candirú specifically says this member of the Siluridae is so little known that he proposes to give a figure and some account of its habits. He writes that its length varies from 2 lines ( $\frac{1}{6}$  or 0.17 in.) to 6 inches, that it avoids deep waters but abounds along the shores, especially in inhabited<sup>1</sup> regions where "it has frequent opportunities of satisfying its instincts." and speaks of the rounded head and suckorial mouth beset with close-set, sharp, almost microscopic teeth. There is no doubt that his fish is a pygidiid, but his figure is so crude, in fact so unlike his description, as to be worthless. After describing the habits of the larger forms (to be referred to later), he continues:

The smaller of the species, the size of which barely exceeds 2 or 3 lines ( $\frac{1}{6}$  to  $\frac{1}{4}$  in., 4 to 6 mm.), are dangerous in quite another respect. Gifted with that faculty so remarkable in trout and salmon, by which they are enabled to mount rapid falls, they introduce themselves into the secret parts of bathers, where their extended fins [spines] retain them captive. Hence the whispered advice which the native bestows on the traveller to avoid passing urine into the water of a bath taken in the river. To the horrible sufferings which the introduction of this living needle may occasion, the Ucayali

<sup>1</sup> For present day confirmation of this, see Dr. de Matta (Part II) as well as others cited elsewhere.

doctors know of but one remedy which consists of a *tisane* made with the *genipa* or *buitach* apple, and which, taken very hot, act, they pretend, on the urinary passages, and dissolves the animal which obstructs them.

Another candirú was collected by the Amazonian explorer Gustav Wallis, and was described by his editor, Karl Müller (1870) as follows:

In these as yet little known waters, particularly in the Huallága, our traveller (G. W.) observed a fish which I wish especially to call to the attention of science. There it is called Candirú and it is rightfully held to be as much the scourge of the waters as mosquitoes and ants are on the land. It itself is only a small thing, scarcely three-quarters of a span long, having a siluroid-like body with a broad rounded head on which the two eyes lie tolerably close to each other, while the two breast fins lie close under it spread out like wings . . . It is a formidable plague for bathers, a species of blood-sucker indeed, which with incredible powers of swimming goes to the body and inflicts a cupping-glass-like wound, and when it has succeeded so that it holds itself fast to the body, it spreads out in the wound a bundle of needles whereby as if with barbs it clings so tightly that only by a painful operation can the fish be separated from the body. This bad habit of the fish is the greater and more dangerous when it seeks out most eagerly the most private parts of the body. Such accidents are related which ended in death as the result of the operation [to remove the fish]. I will therefore take care that this fish, which I have before me in spirits, is put into the proper scientific hands and its scientific name determined since it does not now have one.

This was done and it was described and figured by Lütken in 1891 under the name *Acanthopoma annectens*. His figures of the fish and of the head in both dorsal and ventral aspect are reproduced herein as my Figures 1, 2, and 3, that the reader may at this early stage get a clear idea of the general appearance and peculiar head structures of one of these highly specialized pygidiid catfishes. Particular attention is called to Figure 3 wherein are shown the suckorial mouth beset with teeth

and the spinous pads below the corners of the mouth. Further reference to these will be made later.

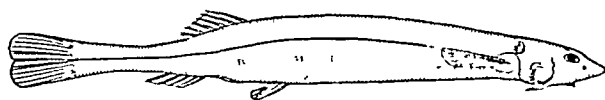


FIG. 1.

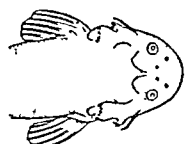


FIG. 2.

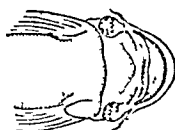


FIG. 3.

FIG. 1. Lateral view of *Acanthopoma annectens* showing slender eel-like form and spinose armature of gill covers.

FIG. 2. Dorsal view of head of same fish showing backwardly pointing spines on upper part of gill covers.

FIG. 3. Ventral view of head of *Acanthopoma*. Note sub-terminal mouth with its many teeth and many backwardly pointing spines on lower part of opercle. (Figs. 1-3 after Lütken, 1891.)

Keller (1874) writes interestingly and apparently at first hand of a number of Amazon and Madeira fishes which he figures. He heard of the candirú as a thin, almost transparent, less than a finger-long fish, dangerous because it "penetrates with eel-like nimbleness into the orifices of bathers and causes many fatal accidents, according to the reports of the riverines." He evidently had no first-hand evidence of this alleged habit.

In 1867 Professor Orton descended the Amazon and heard that "Candirú is the name of two eel-like fishes; and it is also applied to three species of *Serrasalmo* [family Characinidae] all dreaded by bathers." Also that: "The natives accuse a slender Siluroid fish (*Vandellia*) of entering the nether openings of individuals while bathing; but I did not meet with one confirmatory case." Here the name and the fish seem to have been separated and fishes of an entirely different family seem to have been confused in habits with the candirú. However, these points will be taken up later and the confusion cleared up.

In 1884, Steinen, the ethnologist, descended the Xingu from its very head-

waters in Matto Grosso to its junction with the lower Amazon. In his book (1886, p. 150) he lists the candirú among the fishes found in the headwaters (about 14° S. Lat.), and later (p. 178) and much further down the Batovy river (about 12° 8' S. Lat.) he definitely refers to the fish as follows:

We were cautious when bathing. Candirús had been found here. One of them was 2 cm. (0.8 in.) long, a transparent little fish with a yellow iris. They like to push into any available body opening. If, as is said to occur often, they slip into the urethra, the situation is very critical because of the hook-like fins that bury themselves in the mucous membrane. If a hot bath does not bring the disturber out, then the only thing left is an operation. The Sertanejo at that time are said not to have known how to perform urethrotomy, and in many cases death resulted from their heroic treatment.<sup>1</sup>

This is not entirely clear although the translation is exact. The "operation" referred to is presumably amputation, of which more further on. However, it is clear that Steinen, a trained scientist, believed that a real danger existed.

At a meeting of the Zoological Society of London in 1897, Dr. G. A. Boulenger, Curator of Fishes in the British Museum, exhibited specimens of *Vandellia cirrhosa* C. and V. collected by Dr. J. Bach in the course of an exploration of the Rio Jurua, a tributary flowing from the southwest into the Amazon some distance above Teffé. With these specimens, Dr. Bach, a physician in active practice in La Plata on the Jurua, had communicated certain data concerning the habits of the fish, which Dr. Boulenger summarized as follows:

The "Candyrú" as the fish is called, is much dreaded by the natives of the Jurua district, who, in order to protect themselves, rarely enter the river without covering their

<sup>1</sup> My attention was called to Steinen's book by a reference thereto (presumably written by R. Blanchard, the editor) in *Archives Parasitologie*, 1903. This note contains no other data. Attention is called to it here to say so and to keep the bibliography of the subject straight.

genitalia by means of a sheath formed of a small cocoanut-shell, with a minute perforation to let out urine, maintained in a sort of bag of palm-fibres suspended from a belt of the same material. The fish is attracted by the urine, and when once it has made its way into the urethra, cannot be pulled out again owing to the spines which arm its opercles. The only means of preventing it from reaching the bladder, where it causes inflammation and ultimately death, is to instantly amputate the penis; and at Tres Unidos, Dr. Bach had actually examined a man and three boys with amputated penes as a result of this dreadful accident. Dr. Bach was therefore satisfied that the account given of this extraordinary habit of the "Candyrú" is perfectly trustworthy.<sup>1</sup>

In 1877, C. Jobert collected fishes along the Amazon from Pará to Tabatinga, and while on this tour heard much about and obtained specimens of the candirú. However, he seems to have made no use of this data until his attention was recalled to it by Boulenger's note which appeared early in 1898. Jobert then wrote an article (1898) in which he gave his own observations and critically discussed the whole matter. This valuable paper is too long to quote in full, but will nevertheless be studied in considerable detail.

Jobert begins by quoting the scanty literature known to him and especially considers Boulenger's data communicated by Dr. Bach. In short he notes that none of the authors, not even Dr. Bach, had seen the fish *in situ* or had actual unequivocal proof of the penetration. He does not consider the three cases of amputated penes seen by Dr. Bach as necessarily brought about by action of the candirú, but rather by characin fishes, and thinks that the white man was "taken in" by the Indians, although he does not doubt his good faith. However he (Jobert) had not been twenty-four hours in Pará before he had been repeatedly warned against the candirú and urged to follow the custom of the Indians by wearing the constricting ligature. This advice he thought

to be merely an attempt to "take in a tenderfoot," but when this action was insistently urged on him, he came to see that his informants believed that there was danger from the fish. This impression was heightened when he saw his Tapuyos stolidly apply the ligature to their own bodies before going into the water. When he saw how uncomfortable it was to the wearers, he realized that these men had a profound fear of the danger. This realization was heightened by their astonishment and distress at his refusal to so protect himself. He was not attacked, however, and his immunity was ascribed to some secret preparation which he and other whites used. Later on some of the men, emboldened by his immunity, left off the ligature, but Jobert never heard of any accidents.

But for all that he has said, Jobert does think that there is some foundation for these allegations and of this he had actual experience. He adverts to the fact that the Paraenses had warned him against the candirús (using the plural) and he later found that they distinguished two candirús, probably individuals of different ages. They alleged that the smaller was the true candirú, the urino-philous form: and that the other, too large to enter the urethra, was redoubtable for the wounds which it inflicted on the other parts of the bodies of bathers. This the natives called *Candirú de Cavallo*, alleging that it also attacked horses when in the water.

One day Jobert went in bathing in a canal or channel near Pará, where he was warned that candirús abounded. Here he experienced from some small fishes bites, or better scarifications (to be described later), which showed him that there was some foundation for the reports he had heard. Returning to Pará, Jobert related the incident and showed his wounds to a Dr. Castro, a physician of high standing there, and a man much interested in natural history. Dr. Castro assured him that his wounds were made by the fish

<sup>1</sup> The matter of the protective devices made use of will be discussed fully later.



and gave numerous accounts of the alleged penetration of the candirú into the human urethra in the Amazonian region, and added:

I firmly believe in the possibility of such an accident because I have myself extracted from the urethra of a negress a little candirú which had penetrated during micturation while bathing in the river. The patient experienced cruel suffering for since I had to drag the animal out the extraction was difficult, and the mucous membrane was lacerated.

Jobert seems hardly to know what to make of this, but agrees that it can scarcely be dismissed as a figment of the imagination. He says:

We must conclude that there exist in Brazilian waters fishes of small size capable of attacking man, that the hypothesis of a penetration by these objects in a young stage into the urinary organs is agreed on by all the fishermen, that the recital by Dr. Castro and the observations by Dr. Bach on the Rio Jurua tend to make one consider it as established . . . [But] Before coming to a definite conclusion, it is prudent to wait for more exact information.

The distinguished French ichthyologist, Dr. Jacques Pellegrin has described in three papers (1909a, 1909b, and 1911) a curious little Pygidiid (*Vandellia wieneri*), 92 mm. long, collected in 1881 in the Rio Napo at the foot of the Andes under the equator. In his discussion he adverts at length to all the accounts of the activities of the candirú known to him, and while he sets forth no opinion in the matter, it will be easy for the reader to see that his fish might readily be one of the fishes bearing this colloquial name. Pellegrin's account will be given *in extenso* in a later section.

Algot Lange, in a book for popular consumption, gives the following highly colored account (1912) of our fish and its behavior:

I will mention another species, smaller than the *piranha*, yet, although not as ferocious, the cause of much dread and annoyance to the

natives living near the banks of the rivers. In fact, throughout the Amazon this little worm-like creature, called the *kandiroo* is so omnipresent that a bath house of a particular construction is necessary. The *kandiroo* is usually three or four inches long and one sixteenth in thickness. It belongs to the lampreys, and its particular group is the Myxinos or slime fish. Its body is coated with a peculiar mucus. It is dangerous to human beings, because when they are taking a bath in the river it will approach and with a swift powerful movement penetrate one of the natural openings of the body whence it can be removed only by a difficult and dangerous operation.

A small but hard and pointed dorsal fin acts as a barb and prevents the fish from being drawn back. While I was in Remate da Males the local doctor was called upon to remove a *kandiroo* from the urethra of a man. The man subsequently died from the hemorrhage following the operation.

Largely through the danger of the attack from this scourge, though perhaps not entirely, the natives have adopted the method of bathing in use. A plunge into the river is unheard of, and bath-houses are so constructed as to make this unnecessary. A hole about eighteen inches square is cut in the middle of the floor—built immediately above the water—through which the bather, provided with a calabash or gourd of the bread fruit tree [?] dips water up and pours it over himself after he has first examined it carefully. The indigenous Indians, living in the remote parts of the forest, do not use this mode of protection, but cover the vulnerable parts of the body carefully with strips of bark, which render complete immersion less dangerous.

Of the foregoing it seems only necessary to say that the *Kandiroo* is not a lamprey (such not being found in the Amazon), does not belong to the Myxinidae (which are marine fishes), and possesses no dorsal spine. Furthermore it is of interest to note that no other writer on the habits of the candirú records the use of such a bath house, nor has such a bath house been described in the scores of books on the Amazon read by the present writer. Furthermore, Lange says in the preface (p. xi) to another book (1914) that:

"The Amazon region is full of illusory pitfalls. . . . What at first acquaintance appears to be a thoroughly established fact, upon later and closer analysis proves to be a mistake, and *vice versa*." Thus of Remate de Males, which in the extract above quoted would appear to be a locality he says in referring to his first trip: "Then everything was Remate de Males, '*Culmination of Evils*', to my narrower horizon".

To the present writer the whole account quoted seems based on the widespread fear of the piranhas, and this is changed to the candirú story and is highly embroidered to raise a "thrill" in the reader. It is entirely worthless, and is here set forth merely because it has got into the literature, and in order that its utter unreliability may be explicitly shown.

Krause (1911) in speaking of the dangers of bathing in the Rio Uraguana (a tributary of the Tocantins), enumerates piranhas, crocodiles, freshwater rays, "and in the shallow water the candirú fishes, which are all too eager to push into any body opening." Unfortunately, though a trained scientist, he does no more than make this mere mention.

The next Amazonian traveller to be quoted is Woodroffe (1914), who, after speaking of the piranhas which attack bathers, taking bites out of their bodies, adds:

. . . Another terror of the water [is] called "Candirú." This is a small fish sometimes attaining a length of two inches. Just behind the gills it has two barbs, which, when they enter any orifice of the body, open out and act as do the barbs of an arrow, thereby impeding easy withdrawal or expulsion. Although I have never personally seen a case of sickness due to the proclivity of this fish, I do know that in every place which I visited in my travels I have heard of its dangerous character, and am convinced that the river dwellers do speak truthfully when warning one not to be careless of avoiding this danger.

In 1914 Rudolf von Ihering published a fauna of Brazil listing the animals alphabetically in dictionary fashion. Under

the word candirú we learn that this is a scaleless Nematognathous fish, belonging to the family Trichomycteridae, and correctly named *Vandellia cirrhosa*. Further he says that it is "a species native to the Amazon region, correctly accused of introducing itself into the urinary tract of persons micturating when [bathing] in waters inhabited by Candirús." His scientific work having been done in southern Brazil where the fish is not found, his information is plainly second hand, but he is evidently convinced of the truth of the allegation.

We now come to a series of papers on the pygidiid catfishes by the late Dr. C. H. Eigenmann, the outstanding authority on South American fishes. In the first article (1917) he refers in general terms to the evil habits of the candirús. In the second he gives a more extended account, but our main interest is in the last paper (1918b), a great monograph on the Pygidiidae. In this he goes elaborately into the candirú stories and into all the known habits of these fishes as recorded in the literature and as known to him personally. He brings forward no direct evidence bearing on the matter of the candirú (as I shall later) but indicates plainly that he has considerable belief in the oft-told tale. In the matter of the parasitic habits of certain pygidiid fishes, he sets forth certain discoveries of his own which will be presented in a later section. This paper has been of great value to me.

Still later Eigenmann (1922) makes the same general statements in very brief form, and establishes a new genus and species of candirú, *Urinophilus erythrus*, from which one may judge of his belief in the phenomenon under discussion.

The latest account of the vicious habits of this pest is from the pen of Paul Le Cointe (1922) who is director of the "Musée Commercial de Pará" and a laureat and prize winner of the "Société de Géographie" and of the "Société de Géographie Commerciale." His work on

the Amazon is based on first-hand knowledge from long residence in Amazonia. Of the candirú he says:

Very small, but uniquely occupied in doing evil, is the Candirú (*Cetopsis*), which does not grow longer than 5-8 cm. (2-3.2 inches). It often becomes entangled in the meshes of the net by its hooks and then makes bad wounds by means of the spurs on the angles of its fins. The worst is that it penetrates sometimes into the anal and urinal apertures of men and women bathers and there erects the terrible spines which oppose all efforts to extract it, thus causing terrible disorders if it is not gotten out with the greatest care. I have personally known already three cases of this curious accident.

This is the last of the published accounts which I have been able to find. Certain hearsay information which has come to me in the form of letters from ichthyologists will now be considered. Prof. W. R. Allen, who has made extensive collections of the fishes of the headwaters of the Amazon, writes that:

I was told of numerous cases of the candirú's entering the urethra, but they were always some distance downstream, and when I arrived downstream I was told of many such cases upstream. At Iquitos I got on the trail of some cases and followed as far as there was a clue, or a hope, or a shred of a name to inquire about. The most hopeful of these cases turned out to be a real human being. But alas when I got to his home he had just departed by the last launch.

The Peruvians have a larger fish . . . which they say attacks women. I found the Peruvian men rarely entering the water, the women never. This was more due to the fear of the *carnero* [candirú] than of the *paña* (*piranha* of Brazil).

Mr. W. E. Pearson, another of Professor Eigenmann's students, who has collected fishes from the headwaters of the Amazon, has sent me the following statement which he frankly says is based on hearsay evidence:

An interesting account of the candirú of the Rio Beni region was related to me by a former American citizen who now lives in Bolivia.

At the time the incident happened he was living in a rubber station on the Rio Madidi, an affluent of the middle Rio Beni. His Indian wife was a witness and gave him the following details.

As is the custom among the Indians of South America his wife went with other women to wash clothes in the river. Upon entering the water they removed their garments and sat down Indian fashion to do their washing. They were not at work long when one of their number gave an unearthly shriek of pain, jumped up and ran out on the bank. Her companions ran to her and upon examination found that a "candirú" had entered the external genital orifice and had penetrated some distance into the vagina. She was led to a nearby hut where her companions extracted the fish mechanically. The retrose hooks of the opercular apparatus tore into the flesh causing great pain and considerable loss of blood. The crude method of extraction seemed to cause no lasting ill effects for the woman was soon about her work.

The habits of the "candirú" are well known along the entire Rio Beni but very few inhabitants were able to give more than hearsay stories about it. None of these stories related to attacks on males. The female is apparently the only one attacked in this region. It is certain that anything but the very young of the candirú (*Urinophilus erythrus*) of the Beni basin would be too large to enter the urethra of a man.

Last of all Mr. G. H. H. Tate of the American Museum tells me that he got news of this fish in 1926 on the Mapiri River (one of the Bolivian tributaries of the Mamore). The fish is said to be about 3 inches long, bluish, slimy, with spines which it erects after entering an orifice. It is said to occasion great loss of blood, and can only be removed after clipping the spines. It is much feared.

#### THE HABITS OF VARIOUS PYGIDIID CATFISHES AND THEIR BEARING ON THE CANDIRÚ STORIES

In making out a case against the candirú, it will be necessary to marshal the evidence as a lawyer would in court, and in general the habits of these fishes will be analysed

carefully and considered at some length. In this way I shall be able to show a steady and unbroken gradation of habits leading to endoparasitism in certain forms, in those species loosely called candirús. We will begin with the habits fundamental to all catfishes.

*Secretive Habits.* One of the elementary (basal) habits common to all the catfishes (Nematognathi) is that they are bottom dwellers and hidiers, and as such their general tendency is to get out of sight, to hide under logs, stumps, rocks and banks, or even to burrow in mud or sand. This general tendency is particularly marked in the Pygidiidae, where these insinuating habits are helped along by their eel-like bodies and by their peculiar opercular spines.

In the matter of natural hiding places, Eigenmann states (1918a) that one of these pygidiids, Humboldt's "volcano fish," *Eremophilus* ("El Capitan") has the habit of worming its way into holes in the mud and into the banks of streams and of lakes. And again he says that "On the plains of Bogotá the Indians secured the largest specimens of *Eremophilus* by thrusting their arms into the bottom of holes in the banks of streams."

In addition to seeking natural hiding places, certain pygidiids make their own burrows in the sand. Thus Haseman (as quoted by Eigenmann, 1918b, p. 353) says that in 1907 he collected a *Stegophilus insidiosus* in a sand bar in the Rio San Francisco. More specifically Haseman testifies (1911a) that:

In a creek . . . near Santarem, I collected 400 specimens of Candirús (*Stegophilus*) buried in the sand. They are minute and could be seen by millions in this locality, where the water was too shallow to permit the presence of large fishes of any kind. The fishes belonging to the genus *Vandellia*, as well as other genera of the Pygidiidae, lie buried in sand-bars, and I have often seen them when disturbed rise like a flash and bury themselves again in an instant, leaving small round holes where they reentered the sand.

Eigenmann (1918b) says that Mr. E. B. Williamson wrote him of seeing one species climbing the sides of a waterfall probably by means of its opercular spines and suction mouth. Of his own personal experience he writes (1918a and b):

I recall one sultry day sitting in a cool clear brook near Honda, Columbia, leisurely raking my fingers through the sand and pebbles on the bottom. Minute fishes darted out of the sand and into it and under small rocks. I lined a dipnet with cheese-cloth and went for them, dipping up sand, gravel and all. I soon had a good number, 89 to be exact, of a new species of the genus *Pygidium*.

Now if these fishes live their lives largely away from the sun, one would expect them to be comparatively colorless. Thus Keller (1874) records the fact that candirús are small fishes almost transparent in body. Jobert's specimens (1898) taken off the wharf at Pará were "reddish-gray, semi-transparent fishes." Haseman found *Vandellia sanguinea* to be translucent. And finally in Eigenmann's great monograph (1918b), nearly every member of the pygidiid subfamilies Vandellinae and Stegophilinae are noted as being "translucent," "no color marking," or "white." Note will be made of this matter again under endoparasitism.

This common inherent tendency to hide, to creep into a crevice or to burrow in the sand, is the first step leading to an extraordinary and unusual form of parasitism in members of the aforementioned sub-families of the Pygidiidae. The next step is to be found in their food and feeding habits: they are carnivores.

*Carnivorous Habits.* All the catfishes are carnivorous, flesh and blood are the surest baits for them the world over, and the Pygidiidae are not exceptions. Witness Poeppig (1836) who writes of the *caneros* of Pebas (Peru Orientale) that "it was only necessary to let fall into the water a few drops of blood from a shot bird in order to bring together a swarm of these small and voracious animals." In

fact the word *canero* is a derivative of *carnero*, meaning flesh-eater.

That the candirús of the Ucayali are carnivorous was shown by Marcoy in 1869. His Indian companions taught him how to collect these by a method as simple as it is ingenious. His account is as follows:

This little fish, the object of fear and horror to the natives, possessed considerable interest for us. On our return to Tierra Blanca we desired to study it at our ease, and to fish it there was no necessity for lines, berberis [a poisonous plant], or hook. At breakfast or dinner time we took the shell of a turtle which had been killed by Jeanne for the repast, and furnished with this gory trap, to which still adhered a little flesh, we proceeded to the river, in which we immersed it about six inches. The candirús of all sizes, attracted by the bait, instantly darted at the turtle shell; but hardly were they in its cavity than we suddenly raised it out of the water, and thus made two or three prisoners. If we were too busy that day, or were not in the humour to study our captives, we left them in the shell till the morrow, where, gorging themselves with fresh meat, they would get as fat as gold-fish in a globe. Twelve hours' imprisonment, subject to this régime, sufficed for our candirús to pass from the slenderness of early youth to the majestic rotundity of the paterfamilias. Then we released them from their prison either to dissect or paint them. Occasionally we threw them, all alive and frisky in their bath, to the poultry, which fished them up and swallowed them in less time than it takes to record the fact.

Jobert, after his bloodletting by the candirús at Pará in 1876 [presently to be described] sought to collect some of these fish, and was told by an Indian fish-seller in the market that they could be gotten in the river a few yards away. The bargain struck, the Indian hung below the surface of the water just off the wharf the shell of a freshly killed turtle. After fifteen minutes he gently drew it up with a number of reddish-gray semitransparent fish of a maximum length of 4 cm. (1.6 in.). The color and the manner of their capture showed them to be carnivorous, and that they could abrade the skin was proved by

their pricking his fingers with their opercular spines when Jobert essayed to pick them out of the shell.

Haseman (1911a), in his report on his expedition into South America for the Carnegie Museum of Pittsburg, says that: "Piranhas and candirús soon devour other fishes after they have been hooked . . . A freshly killed animal or an imprisoned large catfish left in the rivers over night are sometimes full of Cetopses and parasitic Pygidiids the next morning."

In connection with these blood-sucking habits, it is interesting to note that Eigenmann (1918b) describes as a new species a *Vandellia sanguinea* from the Madeira River and adds that "Mr. Haseman noted that the specimen was white [translucent?], the alimentary canal straight and gorged with blood": hence its specific name. It is undoubtedly a blood-sucker. It should be noted just here that practically all the members of the sub-families Stegophilinae and Vandellinae are white or transparent (some translucent) in color and all have short straight intestines, things which also point to a diet of flesh or blood.

Last of all the published accounts is Le Cointe's (1922) who writes of the candirús that "united in a legion they like to make common cause with the piranhas in order to despoil a dead body of its flesh and even to devour alive a wounded animal which seeks refuge in a water-course." And in a letter received recently Le Cointe reiterates that: "The candirús, which live occasionally in bands of great numbers, are most voracious, and flock by thousands to the dead bodies of animals thrown in the river, leaving at the end of some hours only the perfectly cleaned skeletons."

In the account personally communicated to me by Mr. Pearson, while this paper was being written, is the following pertinent statement concerning a candirú taken in the Rio Beni basin:

A single specimen of *Urinophilus erythrus* was captured one evening as I was using fresh

meat to attract fish that might be near the river's edge. The meat was permitted to float down stream a short distance and there was picked up in a seine. The fish had fastened itself into the flesh by means of the retrorse hooks on its operculum.

From these definite carnivorous habits of these little catfishes, in which there has been practically no hint of parasitism, it is not a far cry to carnivorous habits of these and kindred forms beginning with external parasitism and ending with at least semi-internal living, that in the branchial chambers of the host. In the next succeeding sections evidence will be brought forward to establish this.

*Ectoparasitic Habits of Pygidiid Catfishes.* In the preceding section it has been definitely shown that various members of this family are carnivorous. Herein it will be shown that they go further than this by attacking (attaching themselves to) not only living fishes and mammals but even man himself, in this respect in their smaller way rivalling the fierce attacks of their voracious associates, the piranhas.

The first to make mention of this habit is Marcoy (1869), whose account will now be given. However, it may be said that the fish whose actions he describes might easily be piranhas (Characins) since such are their habits also. However, Marcoy distinctly says that it is a silurid fish (and as he figures a large number of fishes of this order, we must presume that he knew them as such) and he declares that its native name is candirú. Here are his own words:

The larger of these [silurid] fishes, measuring five to six inches in length, make a remorseless war on the calves of the natives who come within their reach: they dart impetuously at the fleshy mass, and rend a portion away before the owner of the calf has time to realize his loss. Never did any disciple of Aesculapius who practised tooth-drawing extract a molar with any greater celerity than these candirús detach the morsel of the living flesh for which they show such a decided liking.

That the next fish (chronologically set out) is a pygidiid there can be no doubt, since it was identified by Lütken (1891) as *Acanthopoma annectens* and this identification still stands. Müller writing from Wallis's notes (1870) says of the candirú of the Huallaga that:

It is a formidable plague for bathers, a species of blood sucker indeed, which with incredible powers of swimming goes to the body and inflicts a cupping-glass-like wound, and when it has succeeded so that it holds itself fast to the body, it spreads out in the wound a bundle of needles whereby as if with barbs it clings so tightly that only by a painful operation can it be separated from the body.

Here we have ectoparasitism definitely established if we are willing to take the word of Wallis coming through Müller. This fish is shown in various aspects in Figures 1, 2 and 3. Study of Figure 3 will show the "cupping-glass" apparatus, the ventral mouth with prickle-like teeth in the upper jaw, and on either side the pads of spines on the lower and inner edges of the opercles, the whole forming a very efficient hold-fast mechanism. It should be noticed that Wallis' description of this bloodletting apparatus is the first ever published.

However, when we come to Jobert's account (1898) we get definite experiential evidence. He had been told in Pará that there were two kinds of candirús; the larger, the *Candirú de Cavallo*, which, too large to enter the urethra, was redoubtable for the wounds it inflicted on the bodies of horses and also of men bathing in the river, and the smaller, urinophilous form alleged to penetrate the genital orifices. Notwithstanding these accounts Jobert one day went in bathing in a channel near Pará, where he had been warned that candirús abounded, and had an experience which we will let him tell in his own words:

I had not been in the water more than five minutes when I felt in the lumbar region, on the abdomen, and on the sides of the chest

some light but rapid strokes of a claw. Seeing the water around me tinged red, I hastened to regain the bank and ascertained that in the

As described above in the section on carnivorous habits, Jobert procured some candirús off the wharf at Pará by the

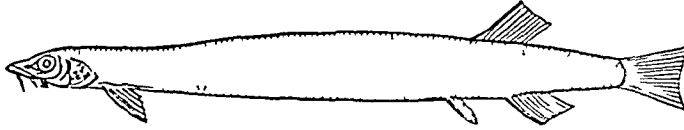


FIG. 4. Lateral view of *Vandellia cirrhosa*, natural size, showing general characters of pygidiid catfishes. (After Cuvier and Valenciennes, 1846.)

regions where I had perceived the sensation of strokes of a claw the blood was escaping from wounds in the form of parallel scarifications, which might have been made by an instrument so regular were they. These constituted groups of five or six lines each of the

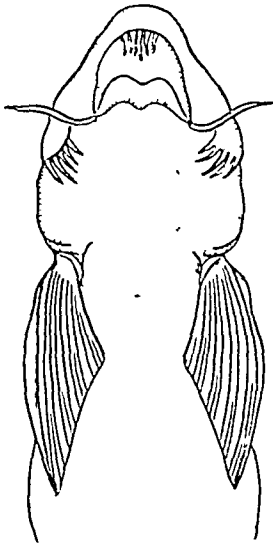


FIG. 5. Ventral view of head of *Vandellia cirrhosa*, showing ventrally placed mouth with 5 teeth in upper jaw, and inward and backward pointing spines on lower part of each operculum. (After Cuvier and Valenciennes.)

length of a centimeter and very close together. I was not able to ascertain their depth but these wounds bled freely throughout their whole length.

His companions evinced considerable satisfaction of the "I told you so" kind, and congratulated him that there were no blood-thirsty piranhas about since had they been present he would not have gotten off so easily. Later when Jobert learned more about the piranhas he realized his fortunate escape. Of the danger of these fishes discussion will be had later.

turtle-shell method. When he tried to scoop the fishes out with his bare hand, they pricked his fingers with their spines. Jobert did not know whether this was the fish that scarified him. However, he reports the facts and says that it was the unanimous opinion that this little fish was the candirú of the legends. He was in doubt as to its classification, realizing the difficulty of separating these small catfishes but concluding that it was nearer Castelnau's fish than Spix and Agassiz'. In 1911 Pellegrin worked over Jobert's collections in the Museum d'Histoire Naturelle in Paris and found these bloodsuckers to be the *Stegophilus insidiosus* of Reinhardt, of which we have heard before and shall hear more a little later.

As to the wounds made, the parallel scarifications and their length precluded the idea of their having been made by biting. These could only have been produced by the spine-like teeth of the mouth or by the erected spines on the opercles when these are widely spread and the gill openings as much distended as possible. Finally Jobert concludes with the statement that there certainly exist in Brazilian waters fishes of small size capable of attacking man and drawing blood.

Study of the mouth parts of *Stegophilus* (Fig. 8) show that these could not have made the parallel scarifications (five or six in number). Pellegrin thinks that the fish which attacked Jobert was a *Vandellia*, and probably *V. wieneri*, whose mouth parts are shown in Figure 10. To this I interpose two objections: first, that of this particular species only one specimen has been taken (high up in the

Andes), and second that as may be seen in Figure 10, it has nine teeth in the upper part of the mouth. On the other hand, *Vandellia cirrhosa* (a lateral view of which is shown in Figure 4) has five teeth in the upper jaw, as may be seen in Figure 5, which would make the sacrifices recorded. Furthermore *V. cirrhosa* is known from many localities on the Amazon and at least as far down as Manaos. However, it is possible that both forms are to be found at Pará.

With regard to external parasitism among the Pygidiidae, our best witness is Haseman, whose remarkable collecting-trip through South America has previously been referred to. One interesting statement (1911a, p. 297) of his is that getting bitten by candirús is one of the dangers besetting the collector of fishes in South America. Again and more explicitly he writes (1911b) that:

Some of the species of the Pygidiidae called "Candirú" attach themselves to any kind of fish or animal, including man. By means of suction, for which their mouths are adapted, they fasten themselves on their victim, and then painlessly cut the skin, and gorge themselves upon its blood. The fishes brought into the market at Manaos often show many wounds inflicted by the Candirús. Below the first fall in the Madeira River it is difficult to take a catfish [these fish lack protective scales] which has not been bitten several times by the Candirús.

Pellegrin has in three papers (1909a, 1909b, and 1911) discussed a curious member of the family Pygidiidae, *Vandellia wieneri*. This little fish (92 mm., 3.6 in. long) was collected in 1881 by Charles Wiener in the Rio Napo under the equator. Pellegrin compares this fish with *V. cirrhosa* C. and *V.* and with Castelnau's *V. plazai*, all three being in the Museum d'Histoire Naturelle in Paris, and finds that all are adapted for a blood-sucking manner of life. However, as will be seen later, his own fish shows the most highly specialized structures fitting it for endoparasitic living.

Next Professor Allen wrote in a personal letter (1926) that:

I have never with my own eyes seen the Candirú attack a human being. And just once have I seen it attacking another fish. In that case it had the head and forward part of the trunk inserted through a perforation of the body wall into the body cavity. . . . One man pointed out to me on his own body a scar that he said was due to an attack of a *carnero*. It was on the abdomen above the inguinal region.

Finally, G. S. Myers (1927) describes a little catfish called *carnero* belonging to the genus *Urinophilus* which when taken was half buried in the abdomen of a large catfish (*Pseudoplatystoma*) caught at Iquitos in Peru. He says definitely that: "It had burrowed directly through the body wall and was distended with blood." Because of this habit he not inappropriately designates it *U. diabolicus*. In the same paper he describes under the name *Haemomaster venezuelae* (the Venezuelan blood-sucker) a little pygidiid taken by Dr. Ternetz on the Orinoco in 1925. Of this he wrote me in 1926: "I have just unpacked a *Vandellia* or *Urinophilus* gorged with blood, which Ternetz said a fisherman gave him on the upper Orinoco, having taken it from a large catfish."

*Endoparasitic Pygidiids.* From what has been recorded in the preceding sections of this paper with reference to the secretive, carnivorous and ectoparasitic habits of these fishes, culminating in their boring into and going into the abdominal cavity of a dead or live fish, or other animal, the reader is not unprepared for an easy transition to what may properly be designated as endoparasitism in the Pygidiidae.

The first to establish the fact of endoparasitic habits in a fish of this family was Reinhardt (1859). He had been led by the reports of perfectly reliable persons in that part of Minas Geraes, Brazil, which he explored, to believe that a huge catfish called *Sorubim* (*Platystoma*) found in the Rio das Velhas (a tributary of the San Francisco) carried its eggs and



young in its capacious mouth. In fact eyewitnesses told him that they had seen the young fishes fall out *from under the gill covers* when this 6-foot catfish was hauled out of the water. Furthermore Reinhardt knew that other South American siluroids practiced oral gestation, and so he determined to try to clear the matter up. He offered the fishermen of Lagoa Santa, where he was collecting, a reward to bring him a *Sorubim* with young in its gill cavities. This led to the interesting discovery which he described before the Natural History Society of Copenhagen in 1858 as follows:

On February 27, 1852, a fisherman brought me a *Sorubim* in the gills of which he said there should be a little "young one." On examination I indeed found there a young fish, hardly an inch long, which was already dead, although the *Sorubim* still showed faint signs of life. The little fish looked so unlike the big one that I was astonished, and upon finding out that the old fish was a male *Sorubim* with a young one, which looked exactly like the first, but was about three times longer, it became clear to me that these two small fishes could in no wise be what it was claimed they were. On the other hand they recalled to me the picture I carried in my mind of a *Trichomycterus* which I had obtained one year previously from the Rio das Velhas under the name of *Cambeja*, or *Bagre molle*. I naturally concluded that the fisherman in order to get the reward offered, had brought me the young of this *Cambeja* and was passing them off as the young of the *Sorubim*. I complained to his face about this procedure, and though I did not obtain any confession from him, I nevertheless had no doubt that I had been made the victim of a swindle. During the few weeks I still remained in Lagoa Santa before starting on my homeward journey to Europe, nothing happened to induce me to think otherwise.

Upon my return home, as soon as I could get access to the literature, and could make a direct comparison between the supposed young of the *Sorubim* and the *Cambeja*, I at once saw that I had made a mistake in assuming that the latter were the young of the former. In short these so-called young of the *Sorubim* were the little fishes which I have had the

honor of exhibiting to the Society. The whole matter became more involved and enigmatical to me, because it appeared that the fisherman, if he had been really guilty of an intended fraud, had for this purpose made use of a fish which was so rare that I had never found it, although I had collected great numbers of the various small fishes in the waters around Lagoa Santa; in fact a fish which I was forced to conclude to be as difficult to obtain as the real young of the *Sorubim*. In 1854, when I again visited Brazil, the solution of the riddle was one of my especial aims. Soon after I arrived at Lagoa Santa in the latter part of November, I indeed reached the solution much more quickly than I had expected, and in the following manner:

A person from the vicinity of Lagoa Santa, but not the same one, who almost three years before had brought me the first *Stegophilus*, came to the village on a Sunday in the middle of December to attend mass according to the custom of the country. He brought with him on this occasion a *Sorubim*, which before he went to church he sold to a Frenchman who had a shop in the town. When mass was over he returned to get his pay, and watched the shopkeeper cut the fish into pieces. He remarked that when the fish had been pulled out of the water there had been five young in its mouth, of which two had remained inside. The shopkeeper looked and actually found the remaining "young," and was kind enough, as he knew the matter would interest me, to immediately bring them to me and relate the circumstances. At the very first glance at the so-called "young" I saw to my surprise that again *Stegophili* had been brought me as the young of the *Sorubim*.

Reinhardt could not believe that there was any attempt to trick him, for there was a total lack of motive. There could hardly be any collusion between this fisherman and the one of three years previous. These men separately could hardly have conceived the idea of the same little fish as the young of the *Sorubim*. No monetary interest was involved since no pay was asked or given, hence the two men would hardly have taken the trouble to work up such an aimless scheme, nor did any one come later to offer *Sorubim*

young. So he came to the belief that he had been entirely wrong in his suspicions and concludes thus:

fish is a parasite and not a commensal, that its slender form fits it to creep between the gill-lamellae of its host, that

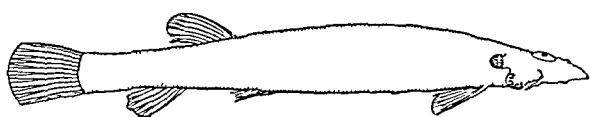


FIG. 6.

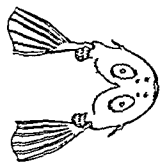


FIG. 7.

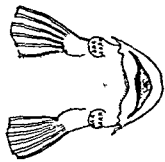


FIG. 8.

FIG. 6. Lateral view of endoparasitic pygidiid fish *Stegophilus insidiosus*.

FIG. 7. Dorsal aspect of head of *Stegophilus* showing opercular spines.

FIG. 8. Ventral view of head of same fish showing mouth more backwardly placed than in *Acanthopoma* (Fig. 3, Note opercular spines. (Figs. 6-8 after Reinhardt, 1859.)

This little fish in reality passes into and abides in the gill-cavities of the *Sorubim*. Its presence there has through an easily explained misinterpretation on the part of the common people given rise in Minas to the story of the *Sorubim's* care for its young.

Tremendously interested by this discovery, Reinhardt made every effort to get other specimens of the *Sorubim* with the included little fishes, but was unfortunately unsuccessful. He did not realize that this was a case of parasitism, though he raised the questions as to what caused the *Stegophilus* to enter this abode, as to whether it got its food in objects brought in its host's respiration, how frequently and in what numbers it is found in the gill cavities of its host, and finally as to whether it stays with the *Sorubim* exclusively or visits other fishes. In naming this little fish *Stegophilus insidiosus* ("the insidious cover-lover") Reinhardt in a remarkable way vindicates the aim of nomenclature, to make the name accurately describe the named.

Figure 6 herein shows the fish in lateral view, and Figures 7 and 8 portray the head in dorsal and ventral aspects to give the details of the gill-cover spines and the teeth in the upper jaw. That this

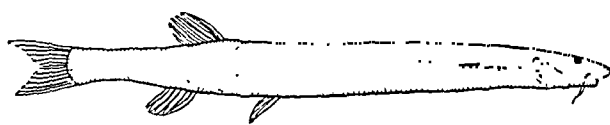


FIG. 9. Lateral view of *Vandellia wieneri* showing ventral mouth and spinose gill cover. (After Pellegrin, 1911.)

the spines on its gill-covers enable it to anchor itself there, that the teeth on its upper jaw enable it to abrade the tender tissues of the gills, and that its ventrally placed mouth enables it to suck in the blood, all may be perceived by a study of these figures. To Reinhardt then is due the credit for first (unknowingly) demonstrating endoparasitism in a pygidiid catfish.

Günther, largely on the strength of Reinhardt's discovery, in his British Museum "Catalogue" (1864) established the sub-family "Siluridae Branchicolae" (silurid gill-dwellers) to embrace *Stegophilus* to which there was every reason to credit the habit of living parasitically in the gills of its huge host, and *Vandellia* whose marked and very close similarity of structure led him to conjecture similar habits in it. However, in 1880, he says that "there is no doubt that they live parasitically in the gill-cavity of larger fishes (*Platystoma*), but probably they enter these cavities only for places of safety, without drawing any nourishment from their hosts," certainly a queer statement since it alleges parasitism and then retracts it.

In two papers published in 1909 and in a third in 1911, Pellegrin makes out an impregnable case for endoparasitism in *Vandellia wieneri*. The first paper was merely preliminary but in the second (1909b)<sup>1</sup> he goes carefully into the classi-

<sup>1</sup> The data contained in Pellegrin's second paper (1909b) is added bodily as an appendix to another paper published in 1911; mention is made of it here that my bibliography may be kept straight. The interested reader is referred to whichever paper is most convenient for him.



his views of the use of the mask-like organ with its aperture. In reply he kindly says: "Concerning *Vandellia wieneri*, without speaking categorically I nevertheless believe that the opening situated in the middle of the membrane masking the mouth serves for the sucking of the blood." The restricted opening of the gills would considerably facilitate the sucking fast of the fish to its host, and finally the short straight intestine is admirably fitted for the ingestion and digestion of a rich concentrated food like blood.

The points brought out by Pellegrin make it clear that his fish is a blood-sucking parasite adapted for penetrating between the gills of large fishes, and that it or a near relative was Jobert's assailant. Just here let us recall Müller's statement as far back as 1870 about his blood-sucker (identified by Lütken in 1891 as the pygidiid, *Acanthopoma annectens*) which "inflicts a cupping-glass-like wound, and when it has succeeded so that it holds itself fast to the body, it spreads out in the wound a bundle of needles whereby it clings so tightly that only by a painful operation can the fish be separated from the body." For these structures see the drawing of the under side of the head in Figure 3.

One other species, *Branchoica bertonii*, belonging to the Pygidiidae, has been taken from the gills of a host. Eigenmann (1918a and b) has found two specimens (the only ones known) parasitic on a large characin, *Piaractus brachypomus*, one from Asunción, Paraguay, the other from Puerto Bertoni, Alto Paraná. Each was 24 mm. (1 in.) long. As one can see from Eigenmann's figures of the fish and of the head, reproduced herein as Figures 11, 12 and 13, this fish has a round ventrally placed mouth, very small gill openings, and opercles beset above and below with spines pointing backwardly and inwardly. In the upper jaw is a large patch of backwardly pointing spine-like teeth largest in the center. At each corner

of the mouth are two other patches of needle-shaped teeth which point toward each other. These with the help of the

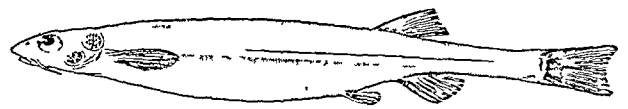


FIG. 11.

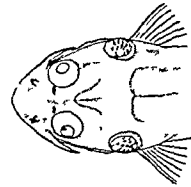


FIG. 12.

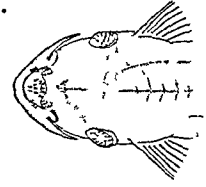


FIG. 13.

FIG. 11. Lateral view of *Branchoica bertonii*. Note ventrally placed mouth and patches of opercular spines pointing backwards and upwards, and backwards and downwards.

FIG. 12. Dorsal aspect of head of *Branchoica*. Note dorsal patches of backwardly and upwardly pointing opercular spines.

FIG. 13. Ventral view of head of *Branchoica bertonii*. Note small mouth with backwardly pointing teeth in upper jaw, and with laterally placed spines on upper and lower jaws pointing more or less toward each other. Note also position and pointing of opercular spines. (After Eigenmann, 1918.)

opercular spines form an excellent hold-fast and bloodletting apparatus. We have then under consideration a fish which in structures and habits and habitat is almost identical with Pellegrin's *Vandellia wieneri* and Reinhardt's *Stegophilus insidiosus*. After a careful study of Figures 11, 12 and 13 there can be no doubt that *Branchoica* (the gill dweller) is an endoparasite in the gill chamber of its characin host. The proofs are overwhelming.

The eel-like bodies of these little pygidiid catfishes of the subfamilies *Stegophilinae* and *Vandellinae* (see Figs. 1, 4, 6, 9, and 11) fit them for penetrating between the gill lamellae of their host fishes, their opercles with patches of spines above and below enable them to hitch themselves forward and to hold fast securely within the gills, their ventrally placed mouths beset with teeth aided by their restricted gill openings enable them to stick fast, their jaws beset with teeth enable them to scarify the gill tissues of their hosts, and finally helped by their very small gill openings their stomachs can suck

in the blood set free: all these things proclaim these fishes as endoparasites. Their gill-penetration and blood-sucking habits have undoubtedly grown out of their primal ancestral habit of creeping under objects and into cavities for protection and for animal food.

Summing up the whole situation, Eigenmann (1918b) comes to the conclusion that probably all members of the extensive family Pygidiidae are free livers *except* the "parasitic *Stegophilinae* and the urinophilous *Vandellinae*." Hence the plain inference is that our evil-minded fishes called candirú belong to the latter groups, as will be set out in a brief résumé.

From the facts set forth as to the capture of *Branchioica bertonii* and *Stegophilus insidiosus* together with their peculiar head, gill and mouth structures, it is clear that gill-chamber parasitism is proved for them. The same structures, together with their blood-sucking habits, lead to the belief that the *Vandellias*, particularly *V. cirrhosa*, *sanguinea*, and *wieneri* are also parasites and probably endoparasites. The case is hardly less strong against *Acanthopoma annectens*, since its head and mouth structures almost duplicate those of *Stegophilus*.

My own belief is that further study of the habits and life histories of the members of the two subfamilies named by Eigenmann will show that they are parasitic, and probably endoparasitic fishes. But the insistent question is: Are there any members of the subfamilies to which the name candirú applies?

(To Be Concluded)

## BOOK REVIEWS

THE PRINCIPLES OF CLINICAL PATHOLOGY IN PRACTICE. By Geoffrey Bourne, M.D. (Lond.), M.R.C.P. and Kenneth Stone, M.D. (Oxon.), M.R.C.P. Oxford Univ. Press, 1929.

The authors have undertaken a meritorious task in making a book which indicates in some detail the laboratory aids useful in the diagnosis of different diseases. They call attention to the need for a publication of this kind, as the textbooks on clinical pathology are devoted chiefly to technic of procedure and those

on general medicine do not elaborate laboratory aids sufficiently. The subject is as extensive as the practice of medicine itself and it has evidently been difficult to decide what to include, and what to omit. There are however, a number of modern and important laboratory aids which have bare mention only. The clinical pathologist would also like to see more attention to biological chemical aids and greater detail in cellular pathology in blood diagnostic aids. Numerous views expressed are evidently personal rather than those generally accepted, and utility should have prompted the voicing of both.

THE FEMALE SEX HORMONE. By Robert T. Frank, A.M., M.D., F.A.C.S. Springfield, Ill., Charles C. Thomas, 1929.

This is a much needed work. There has been so much pseudoscientific mental belly-wash concerning the female sex glands and their secretions that it is a distinct relief and pleasure to read scientific, commonsense paragraphs, amply backed by careful laboratory work by a writer who has carved his name large among the sound men of his calling. To everyone interested in obstetrics, gynecology, surgery, and the sex hormone of the female as related to the wide field of medicine this book becomes a working essential.

One cannot give in outline the book without almost copying it in toto. The researches of Dr. Frank on this subject extend back to 1904 and have been continued to date in several well-known laboratories. The book is divided into two parts: Part I deals with the biology, pharmacology and chemistry of the subject; Part II with clinical investigations based on the female sex hormone blood test. The book is 321 pages long and has 86 illustrations and 36 graphs.

Although even the casual reader will see the text represents the most painstaking and scientific work, yet the book is easily read and one does not have to be a research worker to appreciate it. Any physician will read it with pleasure and profit.

DIE CHIRURGIE. Edited by M. Kirschner and O. Nordmann. Lief. 25. Berl., Urban & Schwarzenberg, 1929.

This part of this monumental system of surgery contains the "Surgery of the Brain" by Dr. Egon Ranzi and the "Surgery of the Vegetative Nervous System" by Dr. F. Bruning and Dr. O. Stahl. The illustrations are beautiful and the bibliography fairly complete even

in the American and English literature. The entire work when complete is on a par with the parts already seen. "Die Chirurgie" by Prof. Dr. M. Kirschner and Prof. Dr. O. Nordmann will be a standard for many years to come.

PRACTICAL LOCAL ANESTHESIA. By Robert Emmett Farr, M.D., F.A.C.S. Ed. 2, revised. Phila., Lea & Febiger, 1929.

Dr. Farr has succeeded in the new edition of his work on "Practical Local Anesthesia" in bringing this subject right up to date. This much discussed topic is covered in a complete and authoritative manner within the scope of a 600 page, well-illustrated volume, which should find a place on the reference shelves of every surgeon.

CANCER. A Practical Resume of the Subject for General Practitioners. By G. Jeanneney. Trans. by John Gibson, M.D., and John H. Watson, M.B., F.R.C.S. Lond., H. K. Lewis, 1929.

This little book on cancer, which has had quite a vogue in France for several years, has now been translated and made available for English reading physicians. It is another plea for the early diagnosis of cancer and for the application of radiation therapy where indicated. Concise and practical, this little book has a definite place in the cancer literature and its perusal will help many general practitioners to answer, in a commonsense way, many of the cancer problems presented to them.

SURGICAL DISEASES OF THE THYROID GLAND. By E. M. Eberts, M.D. with assistance of R. R. Fitzgerald and Philip G. Silver, M.D. Phila., Lea & Febiger, 1929.

According to the foreward of Dr. Archibald: "Here one will find set forth in orderly fashion the knowledge acquired not only, or merely, through the management of many cases, but also through a conscientious study of those cases. . . . The work bears the hallmark of personal experience. And to all this there has been added, as I know, a wide knowledge of the work and opinions of others on both sides of the Atlantic." Within the scope of a duodecimo of 238 pages, Dr. Eberts has attempted to cover the entire subject in fifteen chapters. Necessarily short, the book may be considered a good review or introduction to the subject but it will by no means replace, either in completeness or authoritative presentation, a number of the recent, larger and more detailed books that have appeared both in America and Europe.

DIE ROENTGENDIAGNOSTIK DER INTRATHORAKALEN TUMOREN UND IHRE DIFFERENTIALDIAGNOSE. By Dr. Robert Lenk. Wien, Julius Springer, 1929.

Dr. Lenk's book on "Die Rontgendiagnostik der Intrathorakalen Tumoren und Ihre Differentialdiagnose" is one of the most important additions to roentgen literature in recent years. No German-reading surgeon can afford to be without this book and it is to be hoped that it will be made available to English readers. With remarkable clarity, the author has succeeded in showing the definite help that is to be obtained from the roentgen ray in thoracic cases that so often present almost insurmountable diagnostic problems. The chapter on carcinoma of the lung alone makes this book worthwhile to every surgeon.

COMMON INFECTIONS OF THE FEMALE URETHRA AND CERVIX. By Frank Kidd, M.CH. (Cantab.), F.R.C.S. (Eng.), and Malcolm Simpson, M.B., D.P.H. (Cantab.). With additional Chapters by George T. Western, M.D., and M. S. Mayou, M.S., F.R.C.S. Ed. 2. Oxford Univ. Press, 1929.

The first edition of this worthy book came out in 1924. In bringing out the second edition the authors have not seen cause to alter the original chapters. In their preface they say: "The methods therein described have stood the tests of time and experience, and have become recognized and effective. We have added a chapter describing how to hasten on the time of cure by more intensive treatment, and mentioning certain improvements. . . . We call special attention to the chapter on gonococcal arthritis advocating treatment by early active movements of the joints themselves and condemning splints and plaster."

In the treatment of cervicitis among other measures described is amputation of the cervix. Sturmdorf's excision of the cervical mucosa is not described or mentioned. To our mind this is the only omission of any importance.

The book is well written, above the average in this respect, and should have a wide appeal.

UEBER ORGANHORMONE UND ORGAN THERAPIE. By Geh.-Rat. Prof. Dr. August Bier, Dr. W. Fehlow, Dr. A. Gehrke, Dr. U. Luetkens, and Privat-Doz. Dr. A. Zimmer. München, J. F. Lehmanns, 1929.

Any book sponsored by August Bier is entitled to universal attention and this small volume of 90 pages on organotherapy gives a concise, easily understood resumé of the subject in which German reading physicians will be interested. There are four chapters as follows: Ueber Organhormone und Organtherapie,

Organtherapie der Leber-Gallenwegerkrankungen, Organtherapie bei Nervenkrankheiten und Zur Technik der Tierbluthbehandlung des Morbus Basedow.

DISEASES OF THE CHEST AND THE PRINCIPLES OF PHYSICAL DIAGNOSIS. By George William Norris, M.D., Henry R. M. Landis, M.D., SC.D. With a Chapter on the Transmission of Sounds through the Chest by Charles M. Montgomery, M.D., and a Chapter on the Electrocardiograph in Heart Disease by Edward B. Krumbhaar, PH.D., M.D. Phila., W. B. Saunders, 1929.

Norris and Landis' work has become within twelve years, one of the most used and most quoted books in the library of the American physician. It is of value not only to the internist but also to the general practitioner in whose work physical diagnosis plays such an important rôle. The new edition contains the latest data on all questions within its scope. Not loaded with an extensive bibliography, this book contains footnote references wherever necessary. The editorial judgment of the authors in the matter of omissions is to be as much commended as is the clarity and terseness of the material included. This book of almost a thousand pages, well indexed and well illustrated, is not padded in any way and every word adds to the sum total of the information included within its covers.

GRENZ RAY THERAPY. By Gustav Bucky, M.D. Contributions by Dr. Otto Glasser and Dr. Olga Becker-Mannheimer. Trans. by Walter James Highman, M.D. N. Y., Macmillan, 1929.

So much has been said and written regarding the value, or lack of it, of grenz ray therapy that an authoritative book by the pioneer investigator is welcomed. The physical foundation of grenz ray therapy in this book is written by Dr. Otto Glasser. The balance of this book, covering the historical evolution, principles, anatomic and biologic considerations, the technic, clinical symptoms, dangers and treatment in skin and internal diseases, is written by Dr. Bucky. The book covers the ground thoroughly and provides much food for thought. The author himself says: "I have acceded timidly to the request of the publisher for an exhaustive exposition of grenz ray therapy, for the undertaking seemed premature to me," but thorough use of this book by American physicians will undoubtedly go a long way towards settling the future position of grenz ray therapy.

THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY. By W. A. Newman Dorland, M.D., F.A.C.S. With the collaboration of E. C. L. Miller, M.D. Ed. 15, rev. and enl. Phila., W. B. Saunders, 1929.

The publishers claim that this book has two thousand new words "hundreds of them not defined in any other medical dictionary." The reviewer has not undertaken to check this count but we can say that this edition has withstood a very thorough test and has been found to be the most satisfactory dictionary yet found. The preface states that this edition was revised by Dr. Morris Fishbein with the cooperation of the editorial staff of the American Medical Association. It also states that "In this revision official nomenclatures such as those of the American Chemical Society, the Council on Physical Therapy, the Council on Pharmacy and Chemistry, the Association of Pathologists and Bacteriologists, the American Radiological Association, and similar bodies have been followed." It would seem to be most desirable to have a book where the official nomenclatures of the various specialties are co-related. It is surprising to find in so carefully edited a dictionary that the American Radiological Society is mentioned. Careful investigation reveals no such society and it is supposed that The American Roentgen Ray Society, which some years ago attempted to standardize roentgen nomenclature, is referred to. This book of over 1400 pages is more than a dictionary, it is a veritable encyclopedia with a supplementary posologic and therapeutic table that will probably be one of the most used parts of the book. Illustrations are added where necessary and still there is no padding whatever. Every medical editor will, of course, have this book at his elbow. Every medical author should have it. In fact, as an all round reference work it belongs in the office of every physician.

HANDBUCH DER PRAKTISCHEN CHIRURGIE. Edited by Geh.-Rat. Prof. Dr. C. Garré, H. Küttner, E. Lexer. 6 vols. Vol. I. Chirurgie des Kopfes. Vol. III. Chirurgie des Bauches. Vol. IV. Chirurgie der Wirbelsäule und des Beckens. Vol. V. Chirurgie der oberen Gliedmassen. Vol. VI. Chirurgie der unteren Gliedmassen. Stuttgart, Ferdinand Enke, 1926-1929.

The sixth revised edition of this classic is received with mixed feelings. It brings back memories of the year 1904 when the second edition was published in English under the editorship of the famous Dr. William T. Bull and as "Bull's Surgery" it became, and promised to remain, an outstanding feature of American surgical literature. The English translation was from the second German edition edited by von Bergman, Bruns and von Miculicz. None of the original editors,

therefore, has survived to see this splendid continuation of their work. The feeling of regret that the American edition was not continued and kept up to date is enhanced by an examination of the revised German edition which, under the editorship of Kuettner and Lexer is maintaining in every way the high standard originally set for it. Volume I of this edition was published in 1926 with a statement in the preface that the publishers hoped to issue the complete work by the end of 1927. Accompanying the volumes now before us is the announcement that Volume II, completing the work, will be published in 1930. The difficulties and delays in issuing cooperative compiled works would seem, therefore, to be equally great in Germany as in this country and probably this is an international failing. The latest volumes issued are volumes III on "Surgery of the Abdomen" and volume VI on "Surgery of the Lower Extremities." The articles in the volume by Koerte of Berlin "Surgery of the Peritoneum," "Abdominal Surgery," and "Pancreas" alone make this volume worthwhile, while the 50 page article on the "Liver" by Garré is an outstanding example of *multum in parvo*. The splendid bibliography at the end of each chapter, always an outstanding feature in this work, has been brought up to date and it is refreshing to see the recognition to American literature therein, a thing not to be said of all German works. Practical surgery with reference to the needs of the active surgeon is the keynote of this work. Long philosophic discussions over pathology and etiology that we are so accustomed to in German works are studiously avoided and for quick reference for an active practitioner we know no better work to recommend. The illustrations are well selected and well executed. The type is legible, the paper good and the binding substantial. If memory serves correctly, the five volume translation in 1924 sold for \$30.00 a set. What a commentary on the times that Volume II alone of the new edition costs 99 marks. But this is no fault of the authors or publishers and the work is well worth the price. In fact, compared to some other German publications it may really be called "cheap." Twenty-five years' acquaintance with this work and a thorough scanning of the new edition, far from dimming his enthusiasm, leaves the reviewer with the feeling that the sixth edition is the best that has yet been

published of one of the most practical systems of surgery he has become acquainted with. If you read German, by all means add this work to your library. Would that some William T. Bull of today could induce some enterprising American publisher to bring out a translation of this edition. That it would be at least as popular as the edition of 1904 there can be no doubt.

CLINICAL OBSTETRICS. By Paul T. Harper, M.D., SC.D., F.A.C.S. Phila., F. A. Davis, 1930.

As a clinical obstetrics or a book that deals with the practical side of obstetrics we recommend Dr. Harper's work to every one doing midwifery. It may not appeal to the specialist or teacher of obstetrics as nothing new is added to the well written text. But to the thousands of physicians who look upon obstetrics as a necessary evil and the drudgery part of their work, and who want a book that will straighten them out and give the answers to the common problems they meet every day, we earnestly advise them to own this volume.

THE BLOOD PICTURE AND ITS CLINICAL SIGNIFICANCE. (Including Tropical Diseases). By Prof. Dr. Victor Schilling. Trans. and Ed. by R. B. H. Gradwohl, M.D. Ed. 7 & 8, St. Louis, C. V. Mosby, 1929.

According to the translator's preface, "The world owes a debt of gratitude to Prof. Schilling for his originality, both as a hematologist and as a clinician. He has been courageous enough to enunciate an almost new and original scheme of interpretation of the blood picture in infection. In my experience, I have found corroboration for all his statements that I have had time to follow up. I feel sure that when the great group of American laboratory investigators and clinicians have had time and opportunity to learn these methods, they will find here a great help in everyday practice." To this statement no exception can be taken. With the publication of this book there is no longer any excuse for faulty technic. The author's ideas are presented with true German thoroughness and the translation has been well done. Study of this work by American laboratory investigators and clinicians will probably lead to a more widespread usage of Schilling's methods which have been found so desirable in Europe. The colored plates, while not as good as they might be, answer their purpose. This work represents a real advance in hematology and makes a distinct contribution to diagnosis.



## BOOKS RECEIVED

*All books received by The American Journal of Surgery are listed in this column as soon as possible after their receipt and this must be considered as adequate acknowledgment. Books that the Editor considers of special interest to our readers will be reviewed in a later issue.*

- AFTER TREATMENT OF OPERATIONS.** A Manual for Practitioners and House Surgeons. By P. Lockhart-Mummery, F.R.C.S. (Eng.), M.B., B.C. (Cantab.). Ed. 5, N. Y., William Wood & Co., 1929.
- CANCER PROCESS.** By J. J. M. Shaw. Edinb., E. & S. Livingstone, 1930.
- CLINICAL EXAMINATION OF THE NERVOUS SYSTEM.** By G. H. Monrad-Krohn, M.D., F.R.C.P. Ed. 4, N. Y., Paul B. Hoeber, Inc., 1929.
- CREED OF A BIOLOGIST.** A Biologic Philosophy of Life. By Aldred Scott Warthin, PH.D., M.D., LL.D. N. Y., Paul B. Hoeber, Inc., 1930.
- DERMATEROSES, OR OCCUPATIONAL AFFECTIONS OF THE SKIN.** By R. Prosser White, M.D., C.M., M.R.C.S. Ed. 3, N. Y., Paul B. Hoeber, Inc., 1929.
- DISEASES OF WOMEN.** Symptoms and Treatment. By Franklin I. Shroyer, M.D. Bost., Richard G. Badger, 1929.
- ELEMENTS OF SURGICAL DIAGNOSIS.** By Sir Alfred Pearce Gould, M.D., M.CH. (Oxon.), F.R.C.S. (Eng.). Ed. 7, N. Y., Paul B. Hoeber, Inc., 1929.
- ESSENTIALS OF MEDICAL ELECTRICITY.** By Elkin P. Cumberbatch, M.A., (Oxon.), D.M.R.E. (Camb.), M.R.C.P. Ed. 6, St. Louis, C. V. Mosby Co., 1929.
- ÉTUDES SUR LES MALADIES FAMILIALES NERVEUSES ET DYSTROPHIQUES.** By O. Crouzon. Paris, Masson et Cie, 1929.
- EXPERT (THE).** By Oscar C. Mueller. Los Angeles, Saturday Night Pub. Co., 1929.
- GASTRIC AND DUODENAL ULCER.** By Arthur F. Hurst, M.D. (Oxon.), F.R.C.P. and Matthew J. Stewart, M.B. (Glasg.), F.R.C.P. with the co-operation in the radiological section of P. J. Briggs, M.A. (Cantab.). N. Y., Oxford Univ. Press, 1929.
- GRAPHIC GUIDE TO ELEMENTARY SURGERY.** By Prof. Th. Naegeli, M.D. Translated by J. Soñowman, M.D., M.R.C.P. N. Y., William Wood & Co., 1929.
- HEMORRHOIDS.** The Injection Treatment and Pruritus Ani. By Lawrence Goldbacher, M.D. Phila., F. A. Davis Co., 1930.
- HISTORY OF HEMOSTASIS.** By Samuel Clark Harvey, M.D. N. Y., Paul B. Hoeber, Inc., 1929.
- LIQUIDE CÉPHALO-RACHIDIEN.** Physiologie et Exploration du Système Ventriculo-Méninge. By Riser, M.D. Paris, Masson et Cie, 1929.
- MASTOIDS, ROENTGENOLOGICALLY CONSIDERED.** By Frederick M. Law, M.D. N. Y. Paul B. Hoeber, Inc., 1929.
- NECK, ROENTGENOLOGICALLY CONSIDERED.** By Percy D. Hay, Jr., M.D. Introduction by Henry K. Pancoast, M.D. N. Y., Paul B. Hoeber, Inc., 1930.
- NERVOUS CHILD.** By Hector Chartles Cameron, M.A., M.D. (Cantab.), F.R.C.P. (Lond.). Ed. 4, N. Y., Oxford Univ. Press, 1929.
- OLD AGE.** The Major Involution. The Physiology and Pathology of the Aging Process. By Aldred Scott Warthin, PH.D., M.D., LL.D. N. Y., Paul B. Hoeber, Inc., 1929.
- OPERATIONSLEHRE: ALLGEMEINE UND SPECIELLE CHIRURGISCHE.** By Martin Kirschner and Alfred Schubert. Berl., Julius Springer, 1927.
- OUTLINE OF PREVENTIVE MEDICINE.** Prepared Under the Auspices of the Committee on Public Health Relations, N. Y. Academy of Medicine. Edit. Comm.: Frederick E. Sondern, Charles Gordon Heyd, E. H. L. Corwin. N. Y., Paul B. Hoeber, Inc., 1929.
- PHYSIOTHERAPY.** Theory and Clinical Application. By Harry Eaton Stewart, M.D. Ed. 2, N. Y., Paul B. Hoeber, Inc., 1929.
- PSYCHIATRIE DU MEDECIN PRACTICIEN.** By M. Dide and P. Guiraud. Ed. 2, Paris, Masson et Cie, 1929.
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SUPPLEMENT TO

# *The American Journal of Surgery*

A CLINICAL STUDY OF THE  
ABDOMINAL CAVITY AND PERITONEUM

EDWARD M. LIVINGSTON, M.D.

INTRODUCTION

SECTION I

[In the following pages the Journal page number will be found at the bottom of the page.]

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# A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM

## INTRODUCTION\*

THIS book has been written very largely at the instigation of Mr. Paul B. Hoeber and his associates. The encouragement of the publishers has brought to present form, notes which were primarily gathered simply as a postgraduate review of the abdomen.

Who interested in surgery does not, in one manner or another, conduct such a postgraduate study? It is natural, from the time when problems of surgical practice first replace the fixed routines of a medical curriculum, that more and more attention be given to clinical observations. Their value is increasingly recognized and this makes it necessary that the practitioner repeatedly review undergraduate subjects in an attempt to find some basis upon which to interpret and evaluate bedside findings. Every surgeon, by some method of his own, continually gathers, studies, and seeks to correlate essential facts concerning the abdomen. Carefully to investigate one clinical detail after another represents little more than an effort clearly to understand and adequately to meet daily professional problems.

Studying the  
Abdomen

While to collect such notes is natural, to prepare them for publication is quite another matter. The magnitude of such a task might well stir the temerity of even a learned anatomist or a seasoned clinician. To search through the fundamental branches of medical science: embryology, anatomy, physiology, chemistry, bacteriology, neurology, physical diagnosis,

Compiling a  
Clinical Review

\* This introduction is intended for the completed book rather than for this single issue of the Journal. It is here, therefore, disproportionately long, but gives to the reader an understanding of the scope and character of the volume as a whole, as it will appear throughout the year. Any desiring to omit the reading of the introduction should turn to the heading, Section I, The Cavity, p. 6.

### I

SUPPLEMENT: A. J. S., n.s. Vol. VIII, No. 1, p. 195

for the particular bearing of these subjects upon a problem at hand, is indeed a pleasure. But to present for the consideration of others any large number of surgical topics, intimately involved as they are with the many basic sciences, obviously exceeds the scope of individual authority. Expertness in the presentation of a single phase implies a degree of inexpertness in the presentation of other equally important phases but those far afield from any one specialty. The surgeon when seeking detail or a high degree of precision will always find it necessary to consult numerous separate sources. The single clinical text has inevitable shortcomings. Such a volume can never be in any sense complete, for surgical literature is too vast and new observations and changes are too frequently made. Taking up, also, a mixture of topics, some clinical and some dealing with basic sciences, it is difficult to find a method for presentation which is entirely satisfactory as to logic and arrangement. These difficulties involved in the preparation of a clinical text are too obvious to necessitate discussion.

Advantages of a  
Clinical Text

It is true, however, that the busy practitioner is not always willing to collect his information laboriously and piecemeal. There are times when something of depth would gladly be sacrificed for a greater breadth. The convenience of a single volume broad in scope compensates for certain limitations. The single book touching on many subjects serves as a stimulus, its extensive bibliography acting as a wedge, for an entry into new and broader fields. In addition, the inexpertness which is inherent in such a single volume, both inclusive and comprehensive in character, ensures a certain freshness of viewpoint and an elementary style which might prove of distinct advantage.

Scope of this  
Book

The notes which form the basis for the present text were collected as follows: Taking little for granted, the most commonplace terms were looked up, in order to discover their true significance and complete meaning; accepted eponyms were dealt with by going, wherever possible, to the original sources and there reading the exact words of the men signified

in the eponyms (such names as those of McBurney, Winslow, Fowler, Murphy, Trendelenburg, etc. which so commonly appear in reference to signs, anatomic locations, and methods for treatment, may represent either vagaries of thought or surgical matters of accuracy); an extensive review was made of current literature as it describes clinical points of demonstrated value regarding the abdomen. In a word, the effort has been to make this a comprehensive postgraduate review. The objective is a more perfect understanding of what is observed at the bedside and in the operating room. The effort is to gain added clarity and precision in those matters which most commonly demand the attention of the abdominal surgeon. Yet the work extends beyond this primary object of examining individually the problems of everyday surgery and includes a study of the fundamentals of the medical curriculum. Old subjects are taken up from new angles.

The material of the book has been divided into four sections, namely:

- I. The Empty Cavity.
- II. The Enteric Tract.
- III. The Solid Abdominal Organs.
- IV. The Peritoneal Membrane.

These notes, then, deal with both a microscopic and a telescopic range of vision. Upon the one hand, they seek to focus clearly upon details, for it is in the observance of these that success, both in diagnosis and treatment, very largely depends. But upon the other hand they seek to maintain a degree of far-sightedness capable of seeing in the patient an individual, all of whose organs are dependent one upon the other, and of simultaneously observing both local and general reactions. Through visualizing surgical problems within both the microscopic and the telescopic range, an effort is made to gain the advantages of each while avoiding the disadvantages of either.

The need for such postgraduate study will seldom be denied. To open the peritoneal cavity is a relatively simple act. Similarly, abdominal closure is not, as a rule, a difficult

Need for  
Postgraduate  
Study

procedure. Yet it is a matter far from simple to be certain, after this space has been opened and closed, that in the tense interval of the operation everything has been correctly done to serve the best interests of the patient. Abdominal operations uniformly involve a degree of uncertainty. Even the expert surgeon whose extended experience has repeatedly led him into all regions of the abdomen and has brought him over and over again upon new and unexpected abnormalities, finds this cavity a stimulus to constant study. What surgeon has not seen one intra-abdominal condition mistaken for another; or has failed to encounter pathological changes which were complicated in character involving many structures. The operator is well acquainted with the diversity in the manifestations of the diseases within each single organ; he knows the high incidence of congenital defects, and the wide range of intraperitoneal relationships which must be considered as consistent with the normal. Thus, many operative details cannot be planned in advance but can be settled only during the operation. It is an axiom that the abdominal surgeon must enter the peritoneal cavity "prepared for anything and everything."

Intricacies of  
the Peritoneal  
Cavity

The abdomen presents to the student a veritable puzzle. The intricacies and complications of the peritoneal cavity seem, at times, to be almost without end. Many factors combine to explain this. Among them might be mentioned the size of the space and the number of the organs contained within; the numerous fusions, mesenteries, ligaments and omenta, by which the organs are attached to the parietes; the involved relations of one organ to another, and of all intra-abdominal organs to viscera in other parts of the body; the complex arrangements of blood vessels, lymphatics and nerves; and last but not least the manner in which the peritoneal membrane stretches over and wraps around the walls of the cavity and the surfaces of the structures within, producing a wide variety of bands, folds and fossae. Functional studies are no less confusing. Terminology regarding the abdomen is of mixed origin, is involved and perplexing;

eponyms abound; and available sources for study clearly indicate that much of present knowledge of this region is still elementary and of an incomplete nature. Realizing these difficulties and fully aware of the costs to his patients of the "trial and error" method of learning solely through experience, the conscientious surgeon will spare no expense in time or effort in his preoperative search for operative aids.

With these facts in mind it would seem that no apologies need be made for further time devoted to additional study of the peritoneal cavity and the problems which it presents. Asserting, then, a profound feeling of inadequacy for the present task and a respect both for the importance of the subject and for the learned character of the professional reader, which the book itself might seem to belie; acknowledging indebtedness to the publishers and to early critics for the courage to attempt the work (an undertaking of such scope that the attempt itself is an invitation to unfavorable judgment); seeking and claiming little personal credit in a book intended largely as a review of the work of others; confidently expectant that, due to the many fields necessarily invaded, readers will make reasonable allowance for certain imperfections or even discrepancies which would not be tolerated in a book more specialized in character; and encouraging all suggestions and criticisms, this book is submitted; and by a favorable reception the effort of its compilation will have been, many times over, repaid, while by a reception which is unfavorable the work, following well-established laws, will quickly pass into that oblivion from which no harm can arise. The high aim has been attained if through this study a single operator can be made to feel more at ease during the performance of a single abdominal operation or if a patient in a single instance may thus receive more expedient and effective treatment.

This Publication



## SECTION I

### THE CAVITY

The study of any physical object may well begin from the vantage point of distance. A proper perspective proves invaluable. The abdomen, accordingly, is first studied with reference to its interrelationships with other parts of the body. Particular stress is placed upon those structures which pass into or out of the abdominal cavity connecting it with other regions. The interpretation of practical points concerning abdominal diagnosis and treatment depends upon the ability clearly to visualize the abdomen, not only as an independent structure, but also as an integral part of the individual.

The initial section of this review is confined to a consideration of the abdomen as an empty space, that is, as simply a container for the organs upon which the surgeon must operate. To remove all abdominal viscera reduces greatly the complexity of intra-abdominal arrangements and to investigate the empty cavity before attempting an investigation of the contents of the cavity serves to simplify this study to a marked degree. The following boundaries of the cavity are separately dealt with: (a) the roof (or diaphragm); (b) the floor (or pelvis); (c) the walls (anterior, posterior and lateral).

Certain introductory matters must logically be considered. Important among these is a definition of terms. A review of such preliminary data serves to establish the solid groundwork necessary to an adequate understanding of the involved and complicated details which follow. While the initial portions of this review may appear, in part, somewhat elementary, they contain a discussion of many practical clinical topics. The following subjects for example are taken up: operative routes of approach to various abdominal organs; means for exploring the lower abdomen through orifices of the pelvic floor; the significance of alterations in intra-abdominal pressures; the mechanism by which extra-abdominal disorders

produce abdominal signs and symptoms; diaphragmatic hernia; peritoneal drainage; abdominal topography.

#### DEFINITIONS

*The abdomen* is the body cavity bounded by the diaphragm above and the pelvis below.<sup>1</sup> This corresponds externally to the region extending downward from approximately the level of the nipples to that of the loins. (See Fig. 1, note A.)

The derivation of the word abdomen is probably from the Latin *abdere*, to hide. For this cavity, or cave, effectively hides the normal organs, while in addition its walls serve to conceal the developing fetus or the growing tumor.

*The abdominal cavity* is a term synonymous with the word abdomen. Within this cavity are situated all of the abdominal organs, namely:<sup>2</sup>

1. The greater part of the alimentary canal, viz. stomach, small intestine, large intestine.
2. Digestive glands: liver and pancreas.
3. Ductless glands: spleen and two suprarenal glands.
4. Urinary apparatus: the kidneys, ureters, part of bladder.
5. The peritoneum.
6. Blood vessels, lymph vessels, lymph glands.
7. The abdominal portions of the cerebrospinal and sympathetic nervous systems.
8. Certain fetal remnants.

The abdominal cavity is technically considered to be a space enclosed by the bony and muscular walls of the body.

*The peritoneal cavity*, in contrast, is a potential space inside of the peritoneal membrane and between the viscera. (See Fig. 1, note B.) The peritoneal cavity has been described as a huge lymph sac. Being entirely surrounded by serous lining, it is normally empty except for the fluids elaborated by its walls.\*

*The peritoneum.* This membrane derives its name from the Greek, *peri*, around, + *teino*, to stretch (see tonicity, tension,

\* Authorities may be found who use the terms abdominal cavity and peritoneal cavity synonymously. By the definitions of these authorities<sup>3</sup> (7) the kidneys lie outside of the abdominal cavity and are not, therefore, considered as abdominal organs. Such essential differences as to fundamental definitions clearly indicate the basis for much confusion.

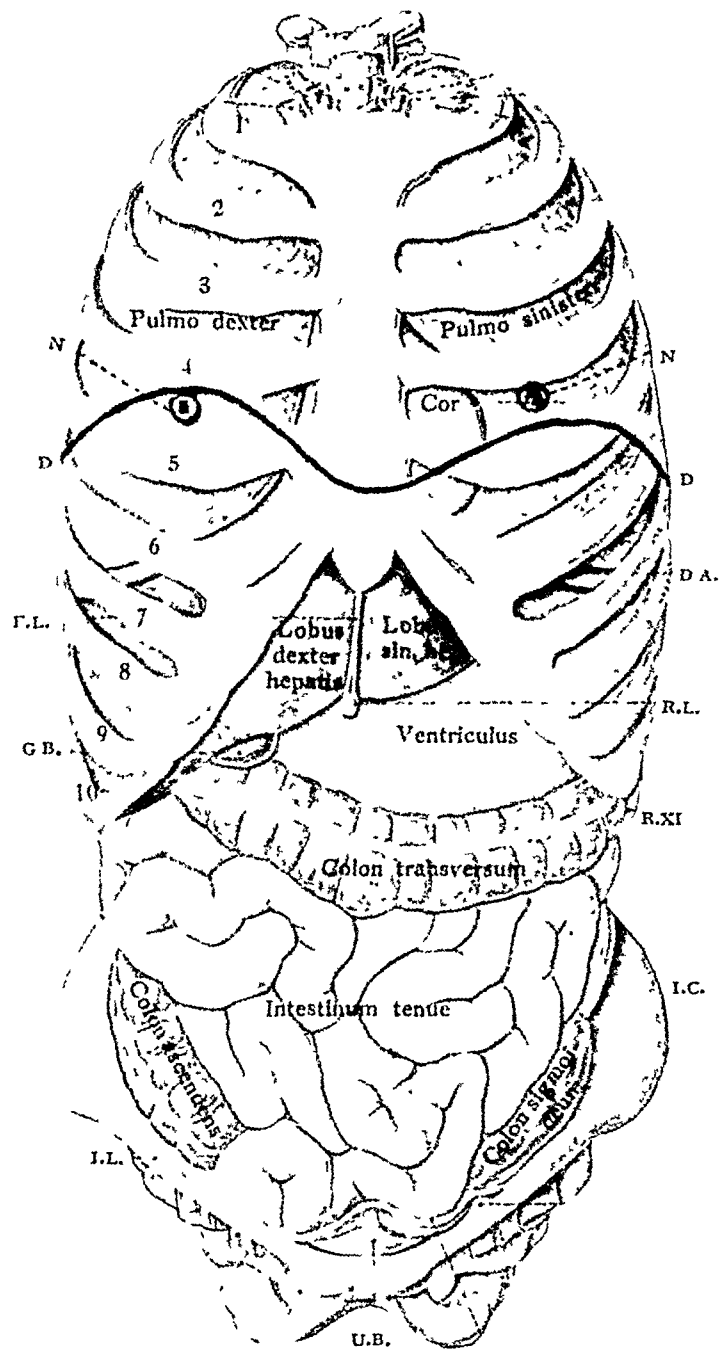


FIG. 1. Ovoid trunk.

Note: (1) The abdomen extends downward from approximately the level of the nipples to that of the loins.

(2) The abdomen is completely filled with organs and the peritoneal cavity (space inside peritoneal membrane and between the viscera) is potential only.

(3) The body, without appendages or parts designed to support or move these appendages, is simply a huge ovoid.

(4) The abdomen extends well upward within the thoracic cage. Ribs serve to protect all organs of the supracolic division of the abdominal cavity.

N, nipple. D-D, upper surface of diaphragm. F.L., falciform lig. G.B., gall bladder. I. L. inguinal lig. (Poupart). U.B., urinary bladder. I.C., iliac crest. R.XI, eleventh rib R.L., round ligament. D A., diaphragmatic attachment. P, peritoneal reflection. (His' model.)

tone). A smooth, lubricated surface is provided by the peritoneum as this structure stretches over or around the various abdominal organs, thus allowing free movement of the viscera in response to their functional activities.

*The abdominal and peritoneal cavities contrasted.* The expressions "intra-abdominal" and "intraperitoneal" are often used interchangeably in surgical literature. The surgeon, as a rule, when entering the abdomen also incises the peritoneum. Yet the differences between the two cavities should be kept in mind. Although both are situated in the region beneath the diaphragm, the abdomen proper ends with the pelvic inlet, while the peritoneal cavity extends well into the pelvis. The peritoneum has been spoken of as the inner lining of the abdomen, but it serves both more and less than this function (folds, raw areas). On cross-section the abdomen appears roughly oval or kidney-shaped but the peritoneal cavity consists of a series of complicated curves or waves formed as the membrane is reduplicated over the various structures suspended from the posterior or lateral abdominal walls. No actual space exists to mark the peritoneal "cavity," for the peritoneal surfaces normally lie in contact with one another unless the approximated walls have been forced apart by some force such as the surgeon's hands, blood, pus, air, or ascitic fluid.

*"Intra"- and "extra"-peritoneal structures.* The surgeon does not think of the peritoneal cavity as an empty space but as one which is literally filled with organs. For convenience, any organ whose walls are quite largely covered by peritoneum is termed "intraperitoneal" (jejunum, ileum) and one which has but slight contact with this serous membrane is referred to as "extraperitoneal" (kidneys, pancreas). The peritoneal membrane is to some degree in contact with every abdominal viscus. To explain this relationship between peritoneum and viscera the former has been compared to an inflated bag and the latter to objects pressed with varying degrees of force against it. Objects but lightly in contact with the inflated

bag would have little of their surfaces covered by bag-wall; while others, strongly pressed against it, would tend almost entirely to disappear and to have their walls almost completely covered by the walls of the bag. Yet in no case would the object described be actually within the bag itself.

*Abdominal section* signifies the act of cutting into the abdomen.

*Laparotomy* (Gr. *lapra*, flank, + *tome*, an incision) means literally an incision into the loin. By common usage, however, the term may signify an incision into any part of the abdominal wall. Thus a lumbar approach to the kidney is correctly termed a laparotomy while a transperitoneal exposure of the same organ is called a laparotomy only through a liberal extension from the original meaning of the word.

*Celiotomy* (coeliotomy: Gr. *koila*, belly; *koiloma*, a hollow) means opening the abdomen or into the peritoneal cavity.

*Peritoneotomy* (self-definitive) is the logical word to signify the act of cutting into the peritoneal cavity, but since the term proves difficult to pronounce it is infrequently employed.

These four terms: abdominal section, laparotomy, celiotomy, peritoneotomy, have come to be used interchangeably.

#### CLINICAL APPLICATIONS

A few clinical observations will serve to make clear the practical significance of these definitions.\*

The Mesenteric  
Stitch

A cross-section of a loop of jejunum or ileum shows that while clinically it may be permissible to refer to these divisions of the small bowel as being intraperitoneal the anatomical fact remains that the peritoneal membrane does not completely

\* This transition from a consideration of definitions to that of clinical matters necessitates an explanatory note. To deal with practical points is, as stated, the primary object of this work. The text will consist, in reality, of a series of isolated paragraphs or entities, each written around a clinical heading as such a practical topic logically arises during the systematic study of the abdomen. These topics will be discussed at whatever length their importance seems to warrant, quite irrespective of proportion and arrangement. To be truly a postgraduate review the subject matter must be elective.

surround the intestinal wall. A "raw" or "uncovered" area exists at the line of attachment of the mesentery. The peritoneum is reflected upward as the right leaf of the mesentery;

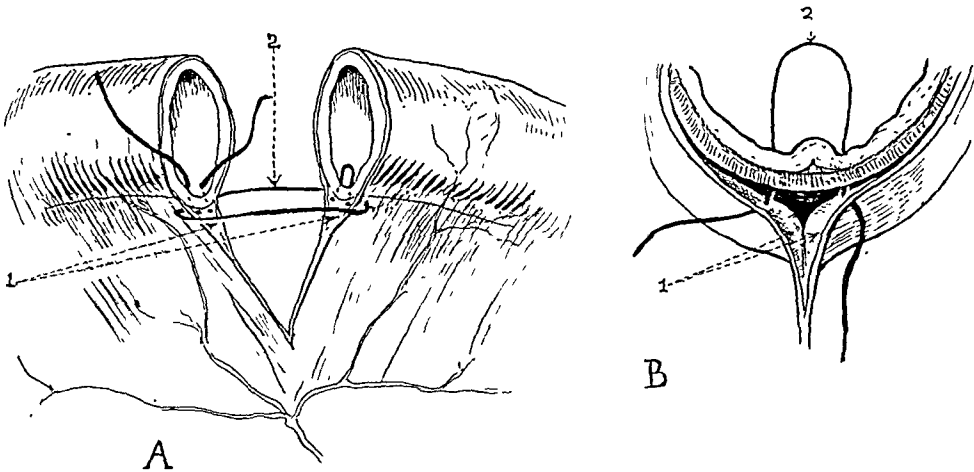


FIG. 2. Mesenteric stitch.

1. "Raw" or "uncovered" area of intestine, where bowel wall is devoid of peritoneum.
2. Suture in position, ready to be tied.
- A. Method for closing raw surface during end-to-end anastomosis of bowel.
- B. Mattress, or u-stitch, employed to close the raw area in a single segment of bowel.

then over the bowel, constituting its outer coat; then downward as the left leaf of the mesentery. This arrangement leaves a small portion of intestinal wall devoid of a peritoneal covering. (Fig. 2.) When performing an intestinal anastomosis it is important that this raw or uncovered area be obliterated, for it has been established that failure of union, infection and stenosis are more frequently observed when this precaution has not been taken. The special stitch used to obliterate this area during an end-to-end anastomosis of bowel, is known as the "mesenteric stitch." It is usually of a mattress variety and therefore ensures a broad approximation of the mesenteric leaves, with a complete closure of the raw area. The sketch of this special mattress or "u-stitch" is self-explanatory. (Fig. 2.) In place of such a special method for taking the stitch the mesenteric gap in each loop may be closed separately by means of a simple transfixion stitch, taken between the two

leaves of the mesentery near the point at which they pass to the bowel wall. Marginal bleeding within the mesenteric gap may be controlled by either the mattress or simple stitch as the mesenteric surfaces are drawn together to close the raw surface. When uncontrolled, this marginal bleeding may lead to the formation of a hematoma which increases in size as the blood burrows between the leaves of the mesentery. Such hematomata are troublesome and are liable to infection, especially from organs of the putrefactive type. The potentialities of such a complication are obvious.

Reaching Abdominal Organs by Retro-peritoneal Routes

Certain other abdominal viscera have larger raw or uncovered areas than do the jejunum and ileum. With some, the surface not in contact with peritoneum is so extensive and is so located that it is possible to deal with them surgically without entering the peritoneal cavity. An extraperitoneal approach may be made to bladder (suprapubic cystotomy); to kidney (pyelotomy); to pancreas (drainage); to a retrocecal mass (appendiceal abscess); to liver (drainage of abscess confined to the falciform ligament (Osler<sup>4</sup>).

"Defenseless Areas" on the Posterior Abdominal Wall

Raw or uncovered areas exist upon the abdominal walls as well as upon viscera. The location and extent of these are made apparent by removing the abdominal viscera together with their membranous and ligamentous attachments. These uncovered areas mark upon the posterior wall the following (see Fig. 3); the root of the mesentery; the root of the transverse mesocolon; the root of the sigmoid mesocolon; an area behind the ascending colon; a similar area behind the descending colon; still another behind the posterior wall of the stomach (see triangular area of stomach); while other such zones mark the attachments of the coronary and falciform ligaments of the liver. These areas have been termed surgically the "defenseless" zones of the abdomen (Crile<sup>5</sup>), because infection readily sets in if these regions become contaminated by pathogenic microorganisms. The peritoneum itself, notwithstanding the surgeon's dread of peritonitis, is very resistant to infection, particularly from colon bacilli or other organisms of the putre-

fective group. Often a slight contamination of the peritoneum occurs without causing any clinical evidence of infection. The same degree of contamination, if occurring in one of the

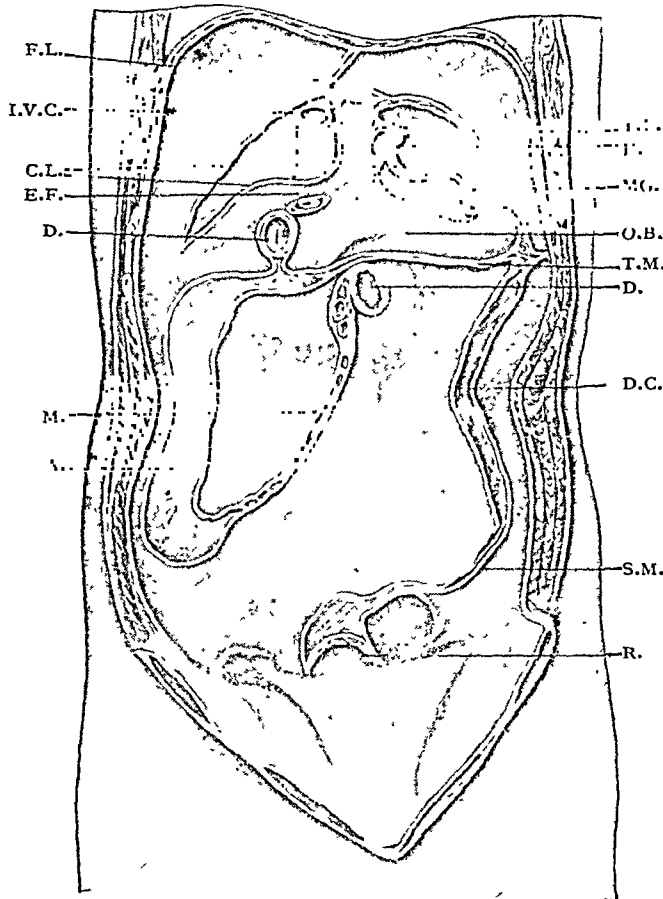


FIG. 3. Empty cavity.

The abdominal organs have been removed, exposing the "raw" or "uncovered" areas of the posterior wall (zones devoid of peritoneum). (After Morris' Anatomy, from McMurrich's Development of the Human Body, Blakiston.)

F.L., falciform ligament. I.V.C., inferior vena cava. C.L., coronary ligament. E.F., epiploic foramen. D., duodenum. M., mesentery of small intestine. A., area of attachment of ascending colon. R., rectum. S.M., sigmoid mesocolon. D.C., area of attachment of descending colon. T.M., transverse mesocolon. O.B., omental bursa. MG., mesogastrium. E., esophagus. T.L., left triangular ligament.

so-called defenseless areas would quite certainly set up a troublesome and spreading inflammation within the retroperitoneal tissues. Great care should be taken while operating,



therefore, to avoid exposure of these uncovered zones to even slight contact with septic material. Again, every effort should be made to "peritonealize" (to cover with peritoneum) raw surfaces such as stumps of organs or suture lines which have been artificially created. In a word, just as the raw areas of organs need protection (see mesenteric stitch), so also do raw areas on the abdominal walls. When however an abscess or well-defined inflammatory process is already present within a retroperitoneal space, it is obvious that this should be drained retroperitoneally and every effort made to avoid spilling a large amount of septic material into the general peritoneal cavity. This fact, however, should not blind the surgeon to the established observation that the peritoneum is definitely more resistant to contamination than are the retroperitoneal tissues. (See Section IV: Pfieffer Phenomenon.<sup>6</sup>)

The abdominal and peritoneal cavities having been defined and differentiated, and their essential differences illustrated by clinical observations, a further approach to practical points will be made through a more systematic review of the various abdominal boundaries.

#### A. THE ROOF OR DIAPHRAGM

1. *Definition.* The body, without its appendages and the parts designed to support or move these appendages, is simply a huge ovoid mass (see Fig. 1, note c). This ovoid contains the body cavities separated from one another by partitions. The largest of these barriers is the diaphragm or midriff (Gr. *dia*, between, + *pragma*, partition; A. S. *mid*, middle, + *brif*, belly). This partition runs obliquely transverse to the long axis of the ovoid, separating abdomen and thorax.

The diaphragm is such an important boundary that the surgeon is well repaid for time spent in a detailed study of this structure. An investigation of the full meaning and accuracy of the synonym midriff, as is often the case in looking up the derivation of a word, serves to focus attention upon details of great significance. In what sense is the diaphragm a

The Thoracic  
Extension of  
the Abdomen

“middle partition?” It is often assumed that the level of the separation between abdomen and thorax is located along the costal margins (i. e., at the level of the diaphragmatic attachments). Thus, not infrequently the upper limit of the abdomen is thought of as extending anteriorly only to the level of the ensiform cartilage. It is true that below this point lies abdominal wall while above it lies thoracic wall. But it is equally true that the abdomen itself (the cavity) extends well above this point. The diaphragm does not, in reality, form a plane but is dome-shaped and over a considerable area abdomen and thorax overlap. This is a point of extreme importance, as will later be made apparent. The midriff, as its name might imply, forms a partition which roughly bisects the ovoid of the trunk at its greatest diameter. (Fig. 1, Line D-D.)

The accompanying illustration (Fig. 1, note 4) shows a typical illustration of the body and its viscera. Here in showing the thoracic viscera the pleural reflections are mapped out as they extend downward to the level of the diaphragmatic attachments. Upon looking at the *abdominal* viscera in this illustration, however, it is found that but a fragment of stomach and of liver may be seen, while there is no evidence of any spleen, pancreas, or right or left colic flexure. It is the continual observation of pictures presented from this angle which, if not actually giving an erroneous impression, at least favors an insufficient attention to the upward extension of the abdomen within the thoracic cage. Another illustration (Fig. 4) shows the trunk containing nothing but the abdominal organs. Here it may be observed that the abdomen extends upward virtually to the level of the nipples; that more than half of the total number of ribs to some extent overlies and serve to protect the abdominal cavity; and that the lower portions of the chest wall, while anatomically thoracic, are functionally also abdominal, to the extent that they act as walls for the abdomen. It will be noted that *the uppermost portion of the abdomen (the cavity) has no abdominal wall* but is covered by diaphragm, visceral pleura, lung, parietal pleura, ribs, and

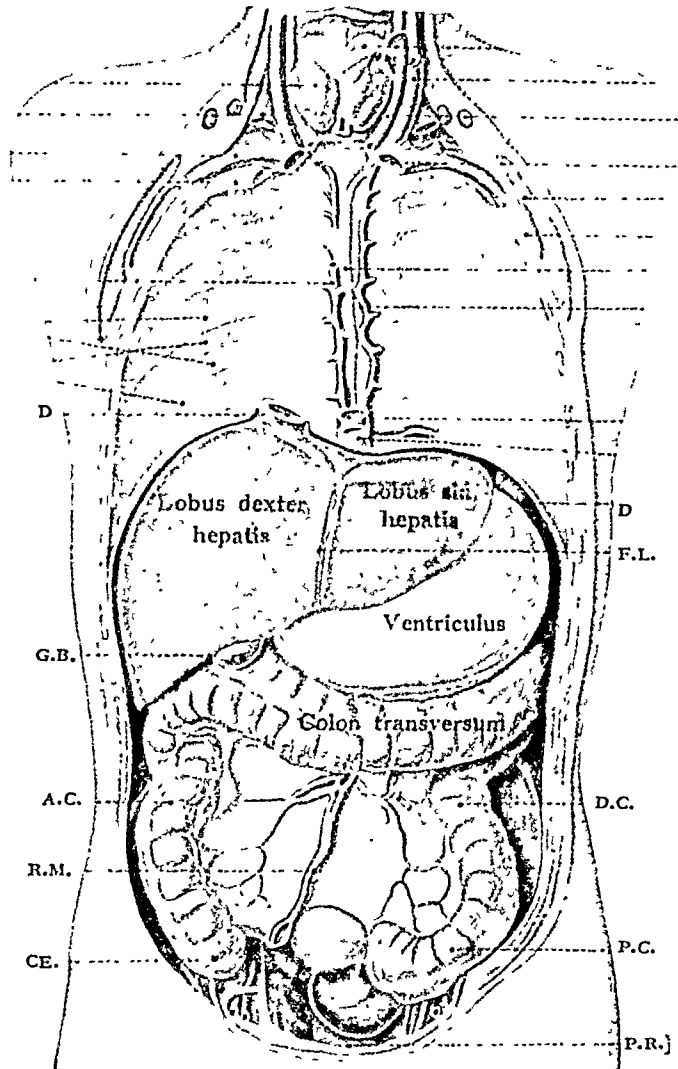


FIG. 4. Abdominal viscera.

Compare with Figure 1. Note: (1) The abdomen extends upward virtually to the level of the nipples.

(2) More than half of the total number of ribs to some extent overlie and serve to protect the abdominal cavity.

(3) The lower thoracic wall serves functionally as a wall for the upper abdomen.

D, diaphragm. F.L. falciform ligament. D.C., descending colon. P.C., pelvic colon. P.R. peritoneal reflection. Ce. cecum. R.M., root of mesentery. A.C., ascending colon. G.B. gall bladder. (Thoracic markings omitted.) (His' model. From Schultze.)

intercostal muscles. The surgeon must deal with each of these layers as he enters the abdomen by the thoracic route.

How general is this disregard of the upward extension of the abdomen may be illustrated as follows: Ask the medical student or even the surgeon to place the flat of his hand over the hypochondrium and in most instances it will be observed that the palm is placed below the costal margins and largely within the epigastrium or a umbar region, rather than over the hypochondrium itself. The terms subcostal and hypochondriac should not be confused. The liver, for example, is an organ of the right hypochondrium yet it is not normally subcostal in location. In speaking of the hypochondriac regions the height to which they extend should be fully appreciated (Fig. 5). While the hypochondriac areas are abdominal topographical zones, they are traced, very largely, upon thoracic walls. (See Section 1: Topography.) Unless full recognition is taken of the fact that the organs of the hypochondriac zones lie for the most part well behind the ribs, an erroneous impression may be gained as to their accessibility. (See Section 11: Mobilization of the Splenic or Left Colic Flexure.) This overlapping of thorax and abdomen has an affect upon intra-abdominal pressures, physical signs, operative procedures, and in general (in manners later to be discussed) has an important bearing upon many phases of the work of the abdominal surgeon. It is of distinct advantage to think of the abdomen in terms of its upper extension and of the position of the diaphragm in terms of its domes as well as of its peripheral attachments.

2. *Origin.* The diaphragm, according to origin, has four parts, a ventral, a dorsal, a right lateral, and a left lateral. It arises chiefly (all of the ventral and most of the lateral portions) from that embryonic structure known as the septum transversum (Fig. 6). This is a mass of developing mesoderm which, as its name implies, lies across the long axis of the embryo. It marks the location of the primitive diaphragm and in addition gives rise to a portion of the liver (vascular

The Hypo-  
chondrium

and connective-tissue elements), to the gastrohepatic ligament (the lesser omentum), to the coronary and falciform ligaments of the liver, and to the inferior portion of the pericardium

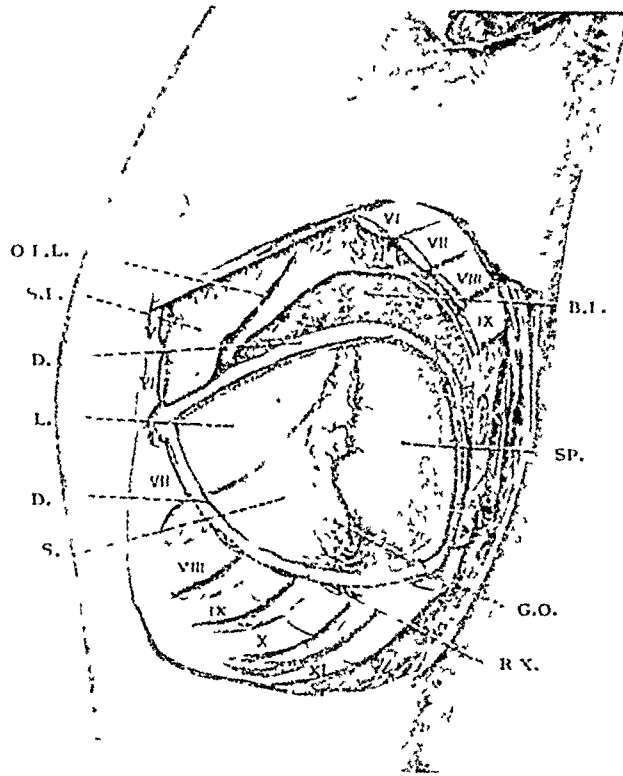


FIG. 5. Dissection of left hypochondrium to show relations of spleen to side wall of chest, diaphragm and adjacent viscera.

In addition to the portions of ribs, there has been removed a part of the base of the left lung, and a window has been made in the diaphragm almost down to the level of the costodiaphragmatic reflexion of the pleura. (From Cunningham's Anatomy.)

O.F.L., oblique fissure of lung. S.L., superior lobe of lung. D., diaphragm. L., liver. S., stomach. R.V., section of tenth rib opposite costodiaphragmatic reflexion of the pleura (dotted line). G.O., greater omentum. SP., spleen. B.L., cut surface of base of lung.

(this fact explains the relationship of the diaphragm to these structures). The lateral portions of the diaphragm spring, in part, from the lateral body walls. The dorsal portion arises from the posterior mesentery of the foregut. These four separate parts of the diaphragm grow towards one another until fusion has occurred.

In some instances fusion is incomplete, leaving a permanent communication between the peritoneal and the pleural cavities (congenital diaphragmatic hernia). Such weaknesses are found

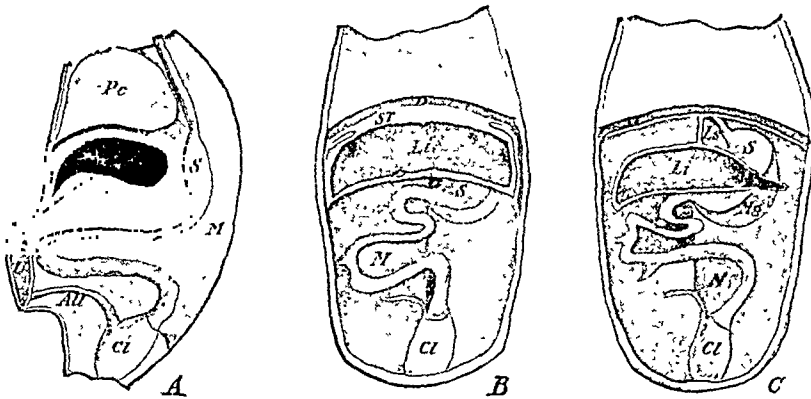


FIG. 6. Diagrams of (a) a sagittal section of an embryo showing liver enclosed within septum transversum; (b) frontal section of the same; (c) frontal section of a later stage when the liver has separated from the diaphragm. (From McMurrich's *Development of the Human Body*, Blakiston.)

ALL, allantois. CL, cloaca. D, diaphragm. LI, liver. LS, falciform ligament of the liver. M, mesentery. MG, mesogastrium. PC, pericardium. S, stomach. ST, septum transversum. U, umbilicus.

chiefly upon the left side, for fusion upon the right side is quite certainly ensured by the presence and early development of the liver. It is stated that of all diaphragmatic hernias one-sixth are congenital.<sup>7</sup> Non-congenital hernias at this site are due to such traumata as bullet or stab wounds; or to rupture of the diaphragm from some sudden increase in intra-abdominal or intrathoracic pressures such as might occur with a crushing wound or with excessively vigorous artificial respirations, etc. Traumatic hernias have erroneously been termed false hernias. Although there is actually a herniation of abdominal contents no sac is present in traumatic cases, a circumstance which serves to differentiate these from congenital hernias. Diaphragmatic hernia should always be looked for in the presence of obscure abdominal symptoms. In general it is true that congenital diaphragmatic hernias have seldom been diagnosed before operation. They are, likewise, seldom cured since the defect often proves too extensive for successful

repair. Fascial plication or fascial transplantation has been advised. Successful operations have been reported in which the stomach was sutured over the hernia defect but this procedure has been condemned due to the frequency with which recurrence follows the procedure. The sac of a congenital diaphragmatic hernia may contain any structure normally located within the upper abdomen. The symptoms are those of the strangulation of some abdominal viscus. Among the symptoms are: pain after eating; pain in the left shoulder; suggestive physical signs such as abnormal tympany or gurgling sound within the chest; hematemesis; cardiac displacement; and dyspnea or dysphagia. Roentgen-ray pictures may prove invaluable.

**Operations for  
Congenital  
Hernias of the  
Diaphragm**

When a congenital hernia is encountered but cannot be easily reduced during the performance of a laparotomy, no time should be wasted in opening the chest (Fig. 5). This often leads to spontaneous reduction of the mass or facilitates manual reduction (see Section 1, Intra-abdominal and Intra-thoracic Pressures). The mortality following operations by the purely abdominal route is stated to be 50 per cent and after those by the transthoracic approach 9.6 per cent.<sup>8</sup> Even when reduction can be accomplished from below, satisfactory suturing of the diaphragm proves difficult. Suturing from above is relative easy due to the shape and accessibility of the diaphragm. When a herniation is known to exist it should be approached through the thorax, turning up a flap of the eighth and ninth ribs if necessary. When reduction proves difficult or if a more complete inspection of the abdominal organs seems necessary there should be no hesitation in cutting through the costal margins to extend the incision into the abdomen or in making a separate median or lateral abdominal incision.

**Herniation  
through the  
Foramen of  
Morgagni**

A relatively uncommon type of diaphragmatic hernia is one occurring through the foramen of Morgagni, located between the sternal and the costal attachments of the diaphragm<sup>9</sup> (see section on eponyms). Such a hernia is also

characterized as parasternal. Hernias through the foramen of Morgagni possess a double sac, one of peritoneum and one of pleura. The peritoneal sac, as it passes above the diaphragm to reach higher levels, dissects the parietal pleura away from the parietal wall and as the hernia enlarges still more the second sac, composed of pleura, is formed.

3. *The Descent of the Diaphragm.* In embryonic life the diaphragm is situated far above its final position. From the original location opposite the first cervical vertebra, it descends through successively lower cervical and thoracic levels. When the fourth cervical level has been reached a mass of muscle tissue grows into the primitive diaphragm and the structure then assumes something of its final musculomembranous character. The muscle tissue of the diaphragm, then, is chiefly derived from the fourth cervical myotome.<sup>10</sup>

This "high" position of the diaphragm is influenced in part by the size of the developing liver. At one time the liver weighs as much as the remainder of the body. Although rapidly diminishing in its relative size, the liver is still a voluminous organ at birth, occupying almost the entire upper half of the abdomen and extending to or below the level of the umbilicus and far into the left hypochondrium. From the first, liver and diaphragm are connected (both being derivatives of the septum transversum) and this association is never completely lost, for within the limits of the coronary and falciform ligaments, these organs retain their contact. This explains why the liver is, in part, retroperitoneal, and why a liver abscess may rupture into the chest or a foreign body may perforate the diaphragm to lodge in the liver without an invasion of the general peritoneal cavity.

Relationship of  
Liver and  
Diaphragm

In early embryonic life the thoracic cavity is relatively small and the abdominal cavity relatively large. Not only does the diaphragm occupy a high position, but so also do the liver, stomach, duodenum, pancreas and spleen. These organs all begin their development at levels above that of the adult abdominal cavity (above adult diaphragm). Thus from an

The Embryonic  
Abdomen



embryological viewpoint the thorax may be considered in a sense as a portion of the abdomen. Indeed the lungs themselves are an outgrowth and secondary development from the gastrointestinal tract. This accounts for many similarities in behavior of the bronchial and the enteric musculature and in the vascular and nervous connections between lung and intestines. This high origin of the upper abdominal viscera has an important bearing upon the final arrangements of their blood vessels and nerves (see Section 11):

**The Phrenic  
Nerves**

4. *Innervation.* The diaphragm receives nerve tissue simultaneously with the receipt of muscle tissue, while at cervical levels. Hence, when the adult or thoracic position is reached the pathway of the descent through the neck and thorax is marked by two long nerve trunks, the phrenic nerves, derived from the third, fourth and fifth (chiefly fourth) cervical segments. These nerves pierce the diaphragm and have terminal branches upon both the upper and lower surfaces of that structure, the richest supply being upon the lower surface.

The word phrenic is related to the term frenzy and is applied to these nerves because of the activity of the diaphragm during emotional states. The rapid, irregular and incomplete respirations and the associated cardiac irregularities observed during periods of emotional stress led to the early belief that the seat of the emotions was located within the thorax.

**Subdiaphragmatic  
Irritation and  
Shoulder Pain**

Certain clinical manifestations demonstrate that the phrenic nerves possess sensory as well as motor fibers. The introduction of gas into the peritoneal cavity (artificial pneumoperitoneum) is often immediately followed by severe pain in the supraclavicular regions or at the shoulder tips. Free blood (ruptured ectopic gestation) or enteral content (perforated peptic ulcer) may produce similar pain. It has been said that this symptom arises because the patient "misrefers" the condition from the actual seat of the sensory disturbance at the peripheral fibers of the phrenic nerve to the supposed seat of trouble in the region of the shoulder tip (that is, the area supplied by the third, fourth and fifth cervical segments: *nervus*

cutaneus colli, and nervi supraclaviculares, anterior, medius and posterior). Other explanations of this pain will be discussed when dealing with the signs and symptoms of abdominal

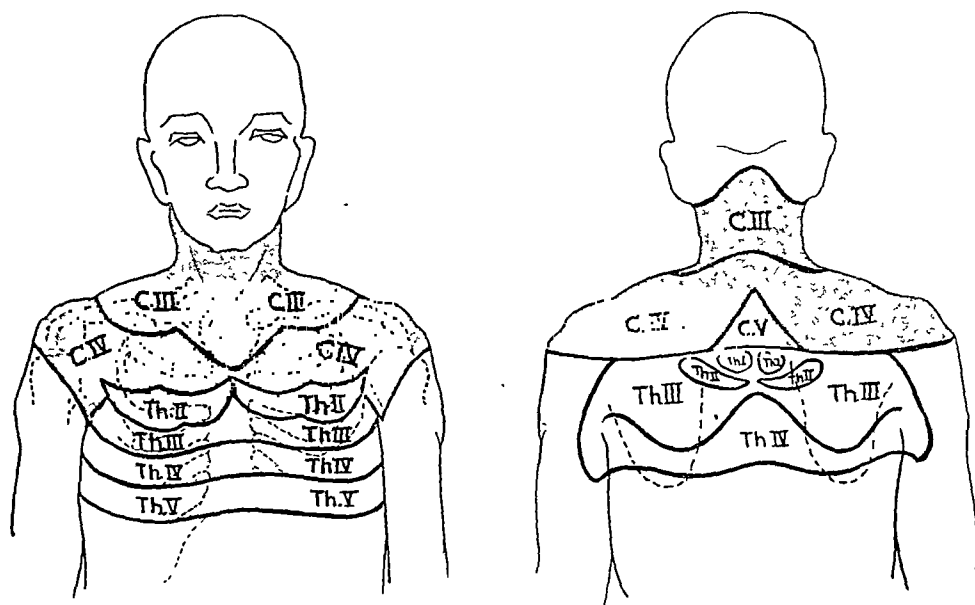


FIG. 7. Cervical sensory collar, showing distribution of sensory fibers of third, fourth and fifth cervical segments. (After Pottenger.)

diseases. The clinical evidence is undeniable that subdiaphragmatic irritation is followed by sensory phenomena: pain, soreness, altered responses to heat and cold, tenderness, hyperesthesia, vasomotor phenomena, in the cutaneous areas of the upper cervical segments. A "sensory collar" (Pottenger<sup>11</sup>) marks the distribution of the sensory nerves. This area extends laterally from the side of the neck to the shoulder tip and vertically from the ramus of the mandible to the upper level of the third rib anteriorly. (Fig. 7.)

The innervation of the diaphragm from cervical levels illustrates an important rule, namely that regardless of subsequent descents, rotations or other changes in position, an organ always retains the central nerve connections which were established during embryonic life. Some of the most valuable diagnostic signs and symptoms are initiated through

The Cervical  
Sensory Collar:  
Cutaneous  
Phenomena of  
C<sub>3</sub>, C<sub>4</sub> and C<sub>5</sub>

Embryonic Nerve  
Pathways

impulses traveling over these nerve pathways, which mark the changes in position the organs have undergone during their development. (See testicular tenderness with kidney disease).<sup>12</sup>

Peripheral and  
Sympathetic  
Innervations  
of Diaphragm

After the diaphragm has descended to its final position the phrenic nerves are joined, according to some authorities, by branches of the ninth, tenth, and eleventh thoracic nerves and these, innervating the periphery of the muscle, allow some motion of the diaphragm even after a total destruction of both phrenic nerves. The anatomical section of one or both phrenic nerves may take place during a bilateral dissection of the neck as for tuberculous glands or malignant metastases. Physiological section may occur during brachial plexus nerve block (regional anesthesia). A bilateral blocking of the brachial plexus has repeatedly occurred without fatal results.<sup>13</sup>

The diaphragm possesses, in addition, a sympathetic plexus. This includes the phrenic ganglion situated at the junction of the right phrenic nerve with the diaphragmatic plexus. Little information is available concerning the exact function of these sympathetic nerves or their clinical significance.

The Vagus  
Nerves

5. *Structures Piercing the Diaphragm.* The roof of the abdominal cavity is pierced, not only by the phrenic nerves, but also by the vagus and splanchnic nerves. The name vagus means "wandering" and is given to those nerve trunks which wander through the neck, thorax and abdomen, innervating adjacent viscera but having no connections with the central nervous system except within the medulla. The vagi innervate the entire intestinal tract, with all its derivatives, from the level of the pharynx to that of the colon. The vagi represent the bulbar portion of the autonomic or parasympathetic division of the involuntary nervous system. (See Section II: Visceral Neurology.)

The Splanchnic  
Nerves

The splanchnic nerves, greater, lesser, and least, represent the sympathetic or thoracolumbar innervation of the intestinal tract. The word splanchnic is derived from the Greek *splanchnon*, a viscus (especially any large abdominal organ) and refers to nerves passing from their origins from the thoracic

portions of the sympathetic paravertebral ganglionated trunks to reach the upper abdominal viscera. The greater splanchnics, right and left, arise from the fifth to the ninth thoracic levels, course over the bodies of the lower thoracic vertebrae to pierce the right and left crura of the diaphragm respectively, and pass to the celiac ganglion or solar plexus. The lesser splanchnics follow the same course and arise from the tenth and eleventh thoracic levels of the ganglionated trunks. The least splanchnics arise from the twelfth thoracic level or as branches of the lesser trunks.

The celiac plexus (Gr. *koeloma*, belly), to which these nerves pass, originally occupies a position opposite the levels from which the splanchnic nerves arise. The recession of the diaphragm, however, forcing the plexus downward, converts the splanchnic trunks into definite cords of considerable length (Fig. 8).

The Celiac  
Ganglion

The foregoing considerations regarding the phrenic nerves, vagi, and splanchnic trunks, make it clear that the entire alimentary tract, from pharynx to distal third of transverse colon, together with all derivatives of this portion of the enteral canal, including lungs, liver, and pancreas, is innervated solely through trunks which originate in or pass through the thorax. Obviously, therefore, the surgeon should consider the thorax to be, at least in part, a functional division of the abdomen. A glance at anatomical pictures of the cavities of the trunk makes it apparent that this innervation of upper abdominal viscera by way of the thorax could not be otherwise (Fig. 8). The organs of the supracolic division of the abdomen lie well beneath the domes of the diaphragm and above the level of the dorsal attachments of this structure. Thus nerves passing to or from these organs (visceral afferent or efferent trunks) would have to pass in a *downward* course to get beneath the margins of the diaphragm and not puncture this barrier on their way to join the cerebrospinal nervous system. But since the true course of these nerves is *upward* (the spinal cord ending at the level of the first lumbar vertebra) it is obvious

Thoracic Course  
of the Abdominal  
Nerves

that the diaphragm must be punctured before the spine is reached. If the nerves of the upper abdominal organs passed to lumbar (abdominal) levels, reflex phenomena from these

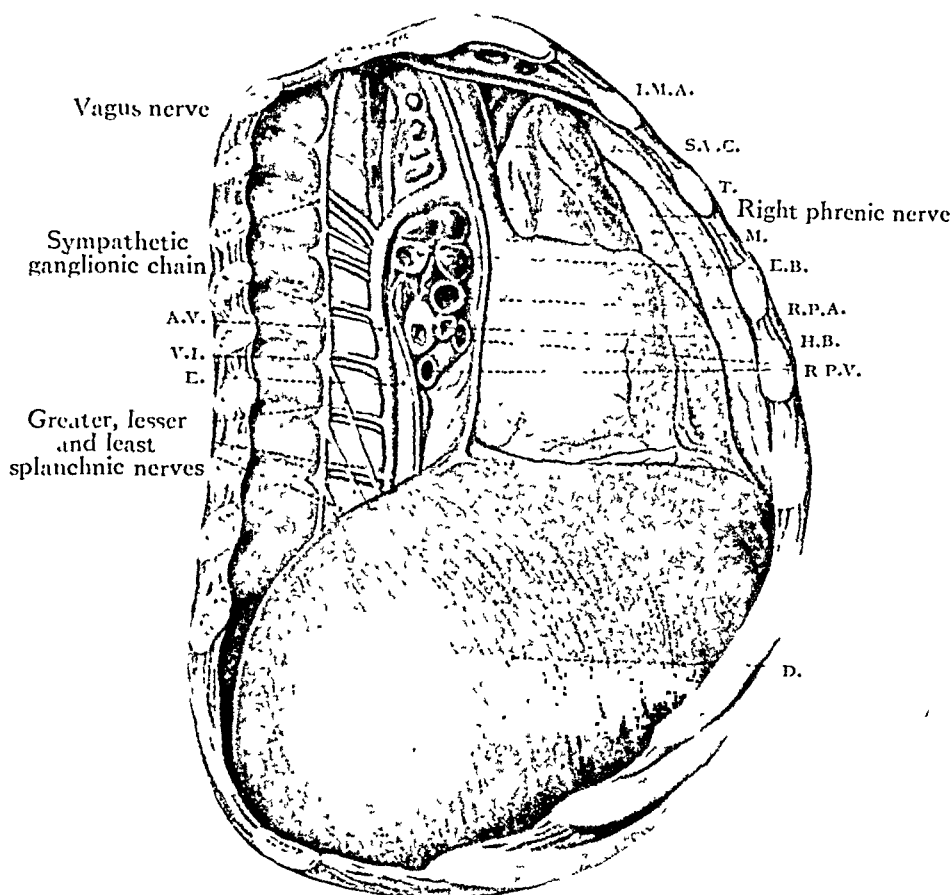


FIG. 8. Thoracic course of abdominal nerves. The roof of the abdomen, viewed from above, showing the nerves which pierce the diaphragm. Note the domed shape of the diaphragm.

A.V., azygos vein. V.I., vasa intercostalia. E, esophagus. D, diaphragm. R.P.V., right pulmonary veins. H.B., hyparterial bronchi. R.P.A., right pulmonary artery. E.B., eparterial bronchus. M. mediastinum. T. thymus. S.V.C., superior vena cava. I.M.A., internal mammary artery. (His' model.)

viscera could not occur within the anterior abdominal wall (innervated by thoracic nerves) but would be observed at levels below that of Poupart's ligament (the sensory level of the first lumbar segment) or in the thighs and legs.

Tumors, inflammations, or other disorders of pulmonary, pleural, cardiac, pericardial or mediastinal origin, may press upon or otherwise *irritate the abdominal nerves in the thoracic part of their course* (Fig. 8). In so doing the thoracic disorder will set up the same reflex phenomena as though the disease were actually located below the diaphragm. Thus, for example, a dissecting aneurysm may produce a boardlike rigidity of the abdomen and a right-sided diaphragmatic pleurisy may closely simulate an acute cholecystitis. The thoracic disorders may provoke additional phenomena which prove of value for differential diagnosis but a simple inspection or palpation of the abdominal wall, without regard to an adequate history or to the examination of other regions of the body, would reveal a perfect "surgical abdomen." Not only may the abdominal disease be simulated, but in large part the identical mechanism is active and the same nerves involved. All too frequently an operation upon the "surgical abdomen" reveals no abdominal pathology while the subsequent course and the accumulation of more complete data disclose that the actual seat of disease is within the thorax (pneumonia simulating acute appendicitis). Such elements of confusion and methods for differential diagnosis will subsequently be more fully discussed. (See section on Visceral Neurology.) The clinical importance of these preliminary anatomical details will be referred to again and again throughout the remaining portions of this book.

Thoracic Disorders Producing Abdominal Signs and Symptoms

To summarize: It has been noted that in early embryonic life the diaphragm is situated at cervical levels and that the region later known as thorax is largely filled with abdominal organs. It has been pointed out that the lungs are an outgrowth and secondary development from the enteral tract. It has been observed that the nerves of the upper abdominal viscera reach the abdomen only after passing through the thorax. The fact has been stressed that the abdomen extends upward well within the thoracic cage. Thus, embryologically, physiologically and anatomically the thorax may be considered, in a very

The Abdominal Surgeon and the Thorax

important sense, as an integral part of the abdomen. The diaphragm is not the hard-and-fast barrier which it is often considered to be, separating the domain of the abdominal surgeon from that of the physician. To understand the abdomen, both for diagnosis and treatment, it is necessary to study not only the abdomen itself but the thorax as well and to focus attention upon all structures which pierce the roof of the abdominal cavity. To study those structures entering or leaving the abdomen and to thus investigate the abdominal cavity as an integral part of the individual and from the perspective of distance is essential to a thorough understanding of the work of the abdominal surgeon.

**Other Structures  
Penetrating the  
Diaphragm**

A more comprehensive list of the structures (thirty-two) which pass through this incomplete and moveable roof of the abdomen is as follows:<sup>14</sup>

The phrenic nerves.

The vagus nerves.

The sympathetic ganglionated trunk.

The greater splanchnic nerves.

The lesser splanchnic nerves.

The least splanchnic nerves.

The esophagus.

The aorta.

The lymphatics.

The inferior vena cava.

The thoracic duct.

The superior epigastric arteries and their venae comites.

The musculophrenic arteries and their venae comites.

The last pair of subcostal arteries and veins.

The venae azygos.

The twelfth thoracic nerves.

6. *Attachments.* Equally important with the study of a "history" of the diaphragm (its development) is that of its adult attachments. The surgeon must know the normal levels of the diaphragmatic domes and how these may be altered by an empyema, subphrenic abscess, or paralysis of a phrenic

nerve; he should know any differences in level between the two domes and the effects upon these of forceful inspiration and expiration. It is only through accurate knowledge of such details that roentgen-ray films or fluoroscopic shadows may be satisfactorily interpreted, the results of percussion evaluated, and proper sites selected at which to enter the highest levels of the abdomen or to drain the lowest limits of the pleural cavities.

The roof of the abdominal cavity is not horizontal but oblique, and the diaphragm is in part a posterior wall as well as a roof (Fig. 9). Anteriorly the diaphragm is attached at the level of the xiphoid process, posteriorly the level is that of the first lumbar vertebra (see crura). A plane constructed between these two points shows that the diaphragm has a tilt which is approximately equal, though in an opposite direction, to that of the pelvis. Laterally the diaphragm is attached to the lower six costal cartilages and follows the obliquity of the costal margins. A line perpendicular to the plane of the midriff, as one perpendicular to the plane of the pelvic inlet, would pierce the umbilicus ( $60^\circ$  from the horizontal). Because of this arrangement, *the posterior abdominal wall of the adult is less than half the length of the anterior wall* (Fig. 9), a fact of significance to the surgeon as he seeks to orient himself within the abdomen.

The Tilt of the  
Diaphragm

Normally the upper surface of the diaphragm reaches the following levels on the bony skeleton during expiration.<sup>15</sup>

The Thoracic  
Floor

a. When viewed from the front:

The midline: to the xiphosternal notch.

The right midclavicular line: to lower surface of the fourth rib.

The left midclavicular line: to upper surface of the fifth rib.

(i.e. the right side is from  $\frac{1}{2}$  to 1 inch higher than the left.)

b. When viewed from the back.

The midline: level of the spine to the eighth thoracic vertebra.



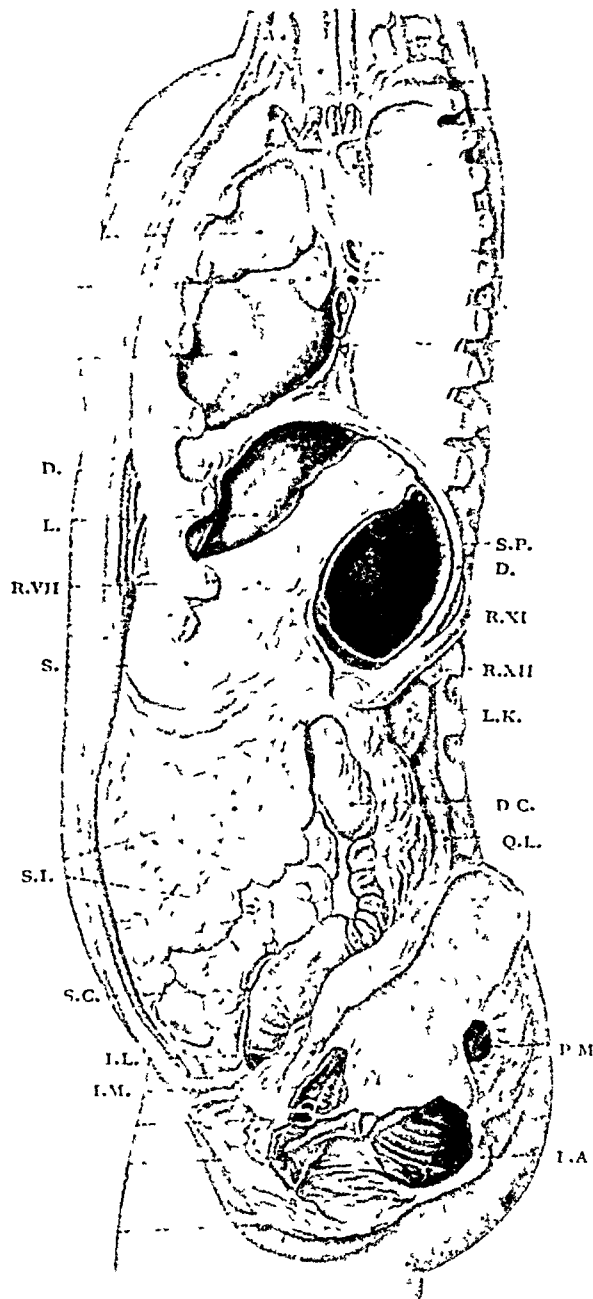


FIG. 9. Tilt of diaphragm.

The posterior abdominal wall is less than half the length of the anterior abdominal wall. Note how completely the abdominal cavity is filled with contents. The peritoneal cavity is potential only.

D, diaphragm. L, left lobe of liver. R. VII, seventh rib. S, stomach. S.I., small intestine. S.C., sigmoid colon. I.L., inguinal ligament (Poupart). I.M., iliopsoas muscle. L.A., levator ani; P.M, piriformis muscle. Q.L, quadratus lumborum. D.C., descending colon. L.K, left kidney. R. XII, twelfth rib. R. XI, eleventh rib. SP, spleen (From Schultze.)

[30]

Right side: level of the angle of the scapula.

Left side: To a point one inch below the angle of scapula.

Posteriorly, neither the upper nor the lower limits of the liver may be mapped out by percussion, for above, the liver is covered by lung and below, liver dullness merges with kidney dullness.

7. *Movements with Respiration.* The variations from these upper limits of the diaphragm which occur during normal respiration are not great, for the diaphragm, although in general a dome-shaped structure, does not move en masse since its central portion is tendinous rather than muscular. The movements take place between the central portion and the peripheral attachment. The two sides being separately innervated, right and left, may function separately.

8. *Surgery of the Diaphragm.* A clear visualization by the surgeon of the shape of the diaphragm, its relations to the skeleton, and of the manner in which thorax and abdomen overlap is essential to a skilfull passage of an aspirating needle in the search for a subphrenic abscess. Before passing through the midriff to reach the abdomen the needle point must traverse, for various distances, the pleural cavity. As the needle is entered through successively higher sites upon the body wall between the levels of the diaphragmatic attachments and domes, greater and greater distances within the thoracic cage must be traversed. As a rule the attempt to localize subdiaphragmatic pus is made by first thrusting the needle through the ninth or tenth intercostal spaces on a line with the angle of the scapula, or in the midaxillary line. If this thrust is unsuccessful, subsequent passages are made through the eighth, seventh, or even sixth intercostal space (the diaphragm being usually elevated above its normal position by the abscess. In passing through the pleural cavity a serous or even purulent fluid may be encountered, for such an accumulation is a fairly constant accompaniment of subdiaphragmatic abscess, and only when the midriff has been punctured will the thick pus which is

Exploratory Puncture for Sub-diaphragmatic Abscess

sought be encountered. It is always dangerous to pass a needle into such an accumulation of pus and this should be done only in an operating room and when the surgeon is prepared for an immediate operation if pus is found. The needle should never be passed from the peritoneal, but always from the pleural side.

The "Negative-  
Pressure"  
Aspirating  
Needle

When searching for a subdiaphragmatic abscess by means of an aspirating needle it proves of advantage to employ the "negative pressure needle" or to aspirate "with vacuum in hand." As the needlepoint reaches the deeper tissues the plunger of the aspirating syringe is drawn backward some distance, thereby creating a partial vacuum within the barrel and needle. Now as the needle point is advanced there is a strong suction in the direction of the syringe and as the abscess is reached the pus pours or springs into the barrel and the abscess is at once revealed. This is distinctly an advantage over the method of repeatedly advancing the needle, then testing, for the latter procedure requires multiple needle thrusts and may produce some bleeding so that as the blood is drawn into the syringe there remains some question as to whether the syringe content is the result of trauma or the abscess has actually been located.

Subphrenic  
Pyopneumothorax

One of the surgeon's most difficult problems in differential diagnosis is that of distinguishing between pus located beneath the diaphragm (subphrenic abscess) and that above the diaphragm (an empyema). The subphrenic abscess, by pushing the diaphragm upward, and particularly because of its frequent association with the large gas bubble (Fig. 10) caused by infection with a gas-forming (putrefactive) organism or the communication with a perforation within a hollow organ, may closely simulate a collection of pus and air within the pleural cavity (pyopneumothorax). Indeed a subdiaphragmatic abscess, if not promptly treated, regularly excites the formation of a pleural exudate and tends to rupture through the diaphragm into the thorax, adding greatly to the confusion in the clinical picture and the difficulty in reaching a correct diagnosis.

A subphrenic abscess associated with gas formation is termed a subphrenic pyopneumothorax.

A subphrenic abscess may be defined as "any abscess in

Subphrenic  
Abscesses

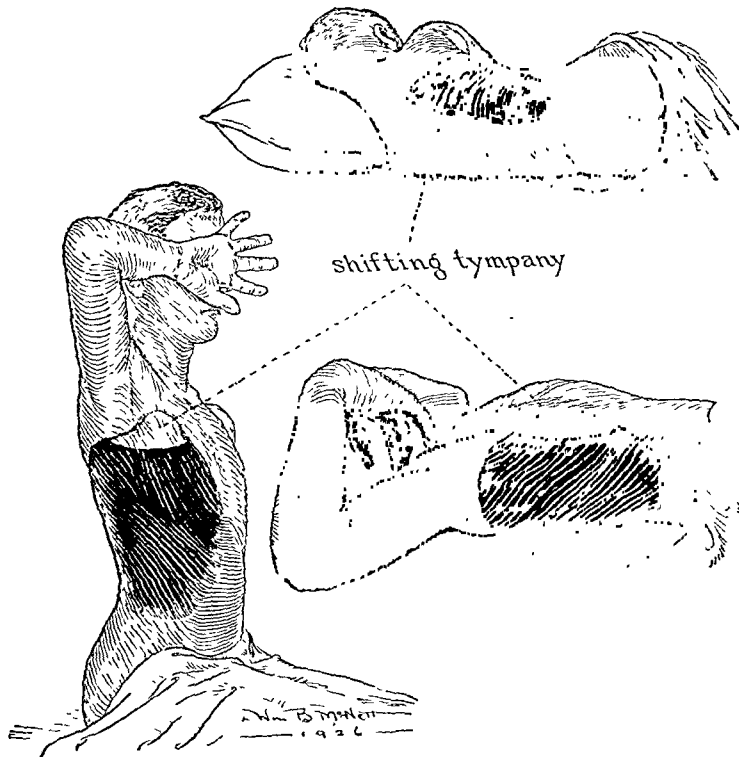


FIG. 10. Right subphrenic abscess following purulent appendicitis showing area of dullness and the shifting tympany from the large gas-bubble. The gas was formed by the colon bacilli. (From Babcock's Textbook of Surgery, Saunders.)

contact with the under surface of the diaphragm, except one situated within the substance of the liver or spleen."<sup>7</sup> Sub-diaphragmatic abscesses are intraperitoneal in more than half the cases and in about half are associated with a gas bubble; over three-fourths are situated on the right side. Retroperitoneal abscesses are confined within the boundaries of the coronary or falciform ligaments, and those on the left side, within the omental bursa. The onset is usually insidious, blending gradually with the primary condition, the etiological factor being, in most instances, a perforation of a peptic ulcer, a gangrenous appendix, or the rupture of a liver abscess.

The pus is ordinarily deep seated, causing symptoms which are indefinite and confusing. Diagnosis is particularly difficult when the abscess is behind or below the liver (the posterior type) or the condition complicated by a secondary empyema. When the abscess points forward the epigastrium may bulge and be tender; when pointing posteriorly the anterior wall may show no signs, the bulge being then in the lower costal area, or loin. (See obliquity of diaphragm.) Enlargement of the liver downward does not ordinarily occur with subphrenic abscess and this condition, when present, favors the diagnosis of liver abscess. Usually the abdominal swelling, when visible or palpable, does not move with respiration. The signs and symptoms are those of deep-seated suppuration anywhere in the body: hectic fever, rigors, rapid pulse, leucocytosis, associated with dyspnea, abdominal distention, local bulging, and elevation of the diaphragm, and an upward (but not a lateral) displacement of the heart. An infrequent sign, but one valuable when observed, is the presence of inflammation about the umbilicus due to an extension of the inflammatory process along the round ligament of the liver.

**Differentiation  
of Empyema and  
Subphrenic  
Abscess**

With empyema, in contrast, there is a lateral displacement of the heart; the process does not involve both abdomen and chest, but is limited to the thorax alone; the thoracic condition involves, not only the lower pleural cavity, but almost the entire side of the space. The costophrenic angle is obliterated, showing examination upon roentgen-ray a flat or fluid line and downward displacement of the diaphragm. The most important evidence in the differentiation is the history. A primary empyema is almost always the complication of a pneumonia or influenza, while with equal frequency a sub-diaphragmatic abscess is the result of the perforation of a peptic ulcer, of appendicitis, or is secondary to a liver abscess.

**Roentgen-Ray  
Interpretation**

It is not always easy to tell from roentgenograms when the diaphragm is at normal and when at abnormal levels. The angle from which the picture is taken may result in distortion. Fluoroscopic exposures and stereoscopic plates prove easier

to interpret in this respect. Roentgenograms taken to demonstrate the location of a collection of pus in relation to the diaphragm must be interpreted more through the relative height of the two diaphragmatic domes (right slightly higher in the normal), the degree and manner of obliteration of the costophrenic angle, and the degree and direction of displacement of the heart, than through the demonstrated relationship between diaphragm and bony skeleton.

The diaphragm tends to be elevated by subphrenic abscesses, depressed by empyema or pleural effusions, and immobilized by either. Any position of the diaphragmatic domes markedly away from the abdomen is termed an eventration of the diaphragm (Gr. *e*, away, + *venter*, belly). The most marked degree of eventration is that which occurs with paralysis of a phrenic nerve.

Eventration of the  
Diaphragm

Methods for dealing surgically with the diaphragm, both by the abdominal and the thoracic routes of approach, have previously been discussed. (See Diaphragmatic Hernia.)\*

\*The next installment will appear in the February issue of the Journal and will deal with the study of the floor and walls of the abdominal cavity.

## EPONYM

## GIOVANNI BATTISTA MORGAGNI

- Eponym:** "Hernia through the foramen of Morgagni."  
Parasternal hernia. Hernia diaphragmatica vera sternalis.
- Name:** Giovanni Battista Morgagni (pronounced mor-gahn'ye).  
In Latin writings: Johannus Baptista Morgagnus.  
In English writings: John Baptist Morgagni.
- Nativity:** Forli, Italy.
- Birth and Death:** Born February 25, 1682, Died December 6, 1771.
- Connections:** Member of Academy at Forli.  
Demonstrator of Anatomy at Bologna, replacing Valsalva.  
Occupied chair of the Theory of Medicine and chair of Anatomy at Padua.
- Education:** Early education received in Forli. Here his great knowledge of literature contributed to his election to the academy at the age of fourteen.  
Received M.D. degree at Bologna in 1701.
- Eponym Source:** Morgagni wrote on this type of diaphragmatic hernia in letter 54 of his book "De Sedibus et Causis Morborum per Anatomen Indagatis," a set of letters, seventy in number, published as five volumes in his seventy-ninth year, and a work written in an unusually interesting and informal style.
- Other Writings:** "Adversaria Anatomica" is the chief work in addition to the "De Sedibus."
- Discussion of Eponym:** Morgagni's description of this hernia is very complete being more informative on the subject than most present-day discussions.  
A score or more anatomical terms are associated with the name Morgagni, including:
- |                |               |                 |
|----------------|---------------|-----------------|
| M.'s appendix  | M.'s tubercle | M.'s valve      |
| M.'s cartilage | M.'s caruncle | M.'s concha     |
| M.'s cataract  | M.'s column   | M.'s fossa      |
| M.'s crypts    | M.'s foramen  | M.'s globules   |
| M.'s frenum    | M.'s glands   | M.'s lacuna     |
| M.'s humor     | M.'s hydatid  | M.'s sinus      |
| M.'s nodule    | M.'s prolapse | M.'s ventricle. |
- Points of Interest:** Morgagni was so capable a teacher and anatomist that at Bologna he had the reputation of being one of the first anatomists of Europe. He gave up teaching to practice medicine at Forli but was dissatisfied because this left no time for research. Hence in 1712 he went to Padua.  
Taught at Padua for nearly sixty years, bringing great fame to the university.  
Lived to an advanced age, dying in his ninetieth year.  
Virchow said that Morgagni "introduced the anatomical idea into medical practice."
- Special References:** Biography from Reference Handbook of the Medical Sciences. Vol. 6; also Walsh..  
James J. Morgagni, the Father of Pathology.  
Eponym from De Sedibus et Causis Morborum per Anatomen Indagatis, Venice, 1762, letter 54.  
Virchow, R. Morgagni und der anatomische Gedanke, Berlin, Hirschwald, 1894.  
Bowditch, Henry I. A Treatise on Diaphragmatic Hernia. Buffalo, Jewett, Thomas, 1853. See pp. 12 and 13, also p. 17 for illustration.
- NOTE:** The author wishes to express indebtedness to Dr. Lewis Francis Ellmore for aid in the study of this eponym.

JO. BAPTISTÆ  
MORGAGNI  
P. P. P.  
DE SEDIBUS ET CAUSIS  
MORBORUM  
PER ANATOMEN INDAGATIS  
LIBRI QUINQUE.

DISSECTIONS, ET ANIMADVERSIONES. NUNC PRIMUM EDITÆ.  
COMPLECTUNTUR PROPEMODUM INNUMERAS, MEDICIS, CHIRURGIS,  
ANATOMICIS PROFUTURAS.

Multiplex præfixus est Index rerum, & nominum accuratissimus.

Præfatus est S. A. D. TISSOT, M.D.

TOMUS TERTIUS,  
EDITIO A MENDIS EXPURGATA ET AUCTA.



EBRODUNI IN HELVETIA.

M. DCC. LXXIX.

FIG. 11A. Title page of Latin Edition.

THE  
SEATS and CAUSES  
OF  
DISEASES  
INVESTIGATED BY ANATOMY:  
IN FIVE BOOKS,  
CONTAINING  
A Great Variety, of DISSECTIONS, with REMARKS.  
TO WHICH ARE ADDED  
Very ACCURATE and COPIOUS INDEXES of the  
PRINCIPAL THINGS and NAMES therein contained.  
TRANSLATED from the LATIN of  
JOHN BAPTIST MORGAGNI,  
Chief Professor of Anatomy, and President of the University at PADUA,  
By BENJAMIN ALEXANDER, M.D.  
IN THREE VOLUMES.  
VOL. III.

LONDON,

Printed for A. MILLAR, and T. CADELL, his Successors, in the Strand,  
and JOHNSON and PAYNE, in Paternoster Row,  
MDCCLXIX.

FIG. 11B. Title page of English Edition.

206 Book IV. Of Chirurgical and Universal Disorders.

upon the drawing asunder of the fleshy fibres, and upon the giving way of the membranes, the stomach, or some part of the intestinal tube, or any other viscus, may pass over from the belly into the thorax.

Thus (beside the passage of the œsophagus of which I shall speak afterwards) I see it is related by Platner (c); that some part of the colon, but a still larger part of the omentum, and pancreas, was carried up through that passage which transmits one of the intercostal nerves; and this happen'd after very violent pains of the intestines.

Thus also, anteriorly, betwixt the fibres that come from the xiphoid cartilage and the neighbouring fibres, there generally is an interval through which something similar may happen: and I even suspected this to have happen'd in a husbandman, in whom I heard that Leprotti saw, at Rome, part of the intestine colon carried up, through the middle and anterior part of the diaphragm, in so great a quantity as to equal a span, when extended.

But as I afterwards heard, from those who had dissected the body, that neither this intestine, nor the foramen, the diameter of which was two thumbs breadths, and through which this part went out and came in, show'd any sign of foregoing violence or disorder, and that the man died in decrepit age, from a manifest injury within the skull; I chose rather to suppose that it had been thus from the original formation:

FIG. 11C. Morgagni's original discussion of the foramen which bears his name.



## EPONYM

## FRANCOIS POUPART

- Eponym:** "Poupart's ligament." Ligamentum inguinale.
- Name:** François Poupart (pronounced poo-part).
- Nativity:** Mans, France.
- Birth and Death:** Born 1661; Died October 31, 1709.
- Connections:** Admitted to Academy of Sciences as a pupil of Mery in 1699.  
Conducted his researches privately while engaged in the practice of his profession.  
Held no teaching chair.
- Education:** Early education, especially in philosophy and humanities, at the Oratory at Mans.  
Specialized in the study of surgery and anatomy at the Jardin du Roi.  
Passed the examinations in surgery at the Hotel Dieu, Paris, with high grades.  
Received his doctor's degree at Rheims.
- Eponym Source:** In 1705 Poupart made an oral communication to the Royal Academy of Sciences in Paris, of which a note is preserved on page 51 of the History of the Academy for that year, describing the ligament.
- Other Writings:** Wrote a "Complete Surgery."  
Contributed to *Journal des Savants* and to *Journal of the Academy of Sciences*.  
Also wrote on mussels, the leech, and the apparition of spirits.
- Discussion of Eponym:** Many authorities declare that Poupart's description of the ligament bearing his name was neither new nor exact.  
Even though the B.N.A. (Basle Anatomical Nomenclature) dropped this eponymic term, students and practitioners will probably always think of the ligamentum inguinale as "Poupart's ligament."
- Points of Interest:** Poupart was an independent worker engaged in a poorly paying practice, and although he carried on his investigations without subsidy, it has been said that he "never allowed his poverty to interfere with his researches."
- Special References:** Biography from Reference Handbook of the Medical Sciences. Vol. 7.  
Eponym from Histoire de L'Academie Royale Des Sciences Année mdcclv, page 51 (page 64 of the Amsterdam edition published in 1707).  
Excellent summary of the historical aspects of Poupart's ligament in *J. Anat. & Physiol.*, Loud, 33: 493, 1898-9.  
**NOTE:** The author wishes to express indebtedness to Dr. Lewis Francis Ellmore for aid in the study of this eponym.

*The Property of* <sup>D E</sup> *The New-York Hospital*  
**HISTOIRE**  
**L'ACADEMIE**  
**ROYALE**  
**DES SCIENCES.**  
 ANNEE MDCCV.

Avec les Memoires de Mathematique &  
 de Physique, pour la même Année,

*Tirez des Registres de cette Academie.*



A AMSTERDAM,  
 Chez GERARD KUYPER, Marchand  
 Libraire à côté de la Maison de Ville.

MDCCVII.

*Avec Privilege de N. S. les Etats de Hollande & de West-Frise.*

FIG. 12A.

FIG. 12A. Title page of book containing Poupart's description.

FIG. 12B. Printed record of Poupart's communication to L'Academie Royale des Sciences, in which the ligament bearing his name is described.

64 HISTOIRE DE L'ACADEMIE ROYALE

V.

M. Poupart a parlé de deux gros Ligaments ronds, fort visibles, puisque dans les grandes personnes ils sont longs de plus d'un demi-pied, & dont cependant les Anatomistes n'ont point traité, apparemment parce qu'ils n'en

ont pas connu les usages. Ils sont attachez par un bout sur la crête de l'Os des Iles, par l'autre bout sur la crête de l'Os Pubis, & le milieu porte à faux. Ils font la fonction d'os en cet endroit, car ils soutiennent les trois grands Muscles de l'Abdomen, c'est-à-dire, l'Oblique externe, l'Oblique interne, & le Transversé. Leurs fibres tendineuses à peu près parallèles entre-elles vont s'attacher à ces Ligaments. Ils sont situés immédiatement au dessous des Anneaux.

La pensée de M. Poupart est qu'ils peuvent soutenir & rompre en partie l'impulsion que de grandes toux, des fauts violents &c. donnent aux Intestins, & par-là les empêcher de s'insinuer entre les Anneaux, & de former des Hernies. De plus ces Ligaments tenant lieu d'Os, quelques Os que la Nature eût mis à leur place, le Ventre en auroit eu moins de liberté de s'étendre, sur tout dans les grossesses. Par ces raisons, M. Poupart appelle ces deux Ligaments *Suspenseurs de l'Abdomen*.

FIG. 12B.

## QUESTIONNAIRE

An ideal method for study is through the use of direct questions and answers. It proves far more difficult to formulate concise answers to specific questions than simply to possess a vague comprehension of subject matter which has been reviewed.

In order to adhere to the purpose of this book and to make of it a postgraduate course, rather than a text for casual reading, a questionnaire is appended to each chapter. Its aim is to focus attention upon salient points, to excite curiosity, to encourage reference to source books, to promote individual thought.

1. What is the abdomen? Is it a section or segment of the body? Is it a cavity? Is it a portion of the body wall? Is it a combination of wall and cavity?
2. What does the word abdomen mean; what is its derivation?
3. Can the terms abdomen and abdominal cavity be used interchangeably? If not, what are the differences in meaning?
4. Give a list of the structures found within the normal abdominal cavity.
5. What is the peritoneal cavity? Can the terms abdominal cavity and peritoneal cavity be used interchangeably? If there are differences between the two cavities, what are they? What is the derivation of the word peritoneum?
6. What is meant when it is said that the peritoneal cavity is potential only?
7. Sketch a cross section of the peritoneal cavity and of the abdominal cavity at any fixed level.
8. What is an "intraperitoneal" structure? An "extraperitoneal" structure?
9. What does the anatomist mean when he says that no organ is actually intraperitoneal?
10. What is the normal content of the peritoneal cavity?
11. What is the meaning of the following: abdominal section; laparotomy; celiotomy; peritoneotomy? Which of these words may be used interchangeably?
12. What is meant by the expression "the raw or uncovered" area of the jejunum and ileum?
13. Draw a cross section of jejunum or ileum showing the relationship between peritoneum and bowel wall.
14. What is a "mesenteric stitch?" What is the object of such a stitch? Varieties of the stitch? Give illustrations.
15. What organs may be approached by retroperitoneal routes?
16. Differentiate and localize: (a) retroperitoneal subdiaphragmatic abscesses; (b) intraperitoneal subdiaphragmatic abscesses.
17. What is meant by the expression "the defenseless zones" of the abdominal wall? Explain.
18. What proportion (roughly what percentage) of the posterior abdominal wall serves as a site of attachment for abdominal organs?
19. What intraabdominal structures are attached to the anterior abdominal wall?
20. When the abdominal organs and their ligamentous or peritoneal attachments have been severed from the posterior abdominal wall, what areas of the abdominal wall are left devoid of peritoneum? Give list.
21. What is meant by the expression "to peritonealize a raw surface?"
22. What is the derivation of the word diaphragm? Midriff?
23. Signify upon the anterior abdominal wall the upper limit of the abdomen.
24. In what manner and in what degree does the abdomen extend within the thoracic cage?
25. Through what layers must the surgeon pass to enter the abdomen by the thoracic route?

26. Distinguish between the subcostal region and the hypochondrium.
27. Name the complete boundaries of the hypochondriac region.
28. How many ribs overlie the abdominal cavity?
29. Describe the origin of the diaphragm.
30. What is the septum transversum?
31. To what adult structures does the septum transversum give rise?
32. What is the cause of congenital diaphragmatic hernias? Upon which side are these most common?
33. What percentage of diaphragmatic hernias are congenital?
34. Give the causes of traumatic diaphragmatic hernias.
35. What is meant by a false diaphragmatic hernia? Is this term well selected? Discuss.
36. Give methods of repairing a large defect in the diaphragm.
37. What are the usual contents of diaphragmatic hernias?
38. Give the chief signs and symptoms of diaphragmatic hernias.
39. By what routes may a diaphragmatic hernia be approached surgically? Discuss. advantages and disadvantages of each. Give the mortality with each.
40. What is a hernia through the foramen of Morgagni? Why does this type of hernia possess two sacs? Of what are these sacs composed?
41. At what level does the diaphragm originate?
42. Since the diaphragm occupies at various periods of development each of the cervical and upper thoracic levels, why is its chief innervation derived from the fourth cervical level?
43. From what myotome is the muscle of the diaphragm derived?
44. Discuss the anatomical relationship between diaphragm and liver. State some clinical observations based upon this relationship.
45. How may a foreign body get into the abdominal cavity through the diaphragm without entering the general peritoneal cavity?
46. In what sense may the thorax be considered a functional part of the abdomen?
47. What are the derivatives of the gastrointestinal tract?
48. Give a list of thirty or more structures which pass between abdomen and thorax.
49. What is the derivation of the word phrenic?
50. Explain the shoulder pains due to subdiaphragmatic irritation.
51. Give a sketch of the specific nerve pathways involved in the above.
52. What intra-abdominal conditions most commonly give rise to shoulder pain?
53. What other phenomena are noted in the cervical region in association with shoulder pain of abdominal origin?
54. What is meant by the term "the cervical sensory collar?" Give its limits.
55. State the innervation of the diaphragm in addition to that through the phrenic nerves.
56. What is the derivation of the word vagus? Splanchnic?
57. What are the splanchnic nerves? How many splanchnic nerves are there? Give their origin and course.
58. What is the vegetative nervous system? The autonomic nervous system? The sympathetic system? The parasympathetic system?
59. What parts of the alimentary tract are innervated by the vagi? By the splanchnics?
60. What is the celiac ganglion?
61. What part of the enteral canal is innervated by nerves which originate in or pass through the thorax?
62. What abdominal symptoms are caused by pressure upon, or irritation of abdominal nerves in the thoracic part of their course?
63. What thoracic disorders most commonly simulate abdominal diseases?

64. What is meant by "the surgical abdomen?"
65. Can thoracic disorders produce this condition?
66. Why do so many of the afferent and efferent trunks of the abdominal viscera pierce the diaphragm?
67. What sensory area is innervated by the first lumbar spinal segment?
68. In what sense is the diaphragm a barrier separating the domain of the abdominal surgeon from that of the physician?
69. Why is it necessary to study the thorax in order properly to understand the abdomen?
70. What is meant by the statement that "embryologically, physiologically, and anatomically the thorax may be considered, in a sense, an integral part of the abdomen?"
71. What is the relative length of the anterior and of the posterior abdominal walls?
72. What is meant by the tilt of the diaphragm?
73. Name the normal levels of the domes of the diaphragm (a) when viewed from the front; (b) when viewed from the back.
74. Describe the movements of the diaphragm with normal breathing.
75. Name the sites at which a needle may be introduced in searching for a subphrenic abscess. To what depth must the needle be thrust to enter the abdomen?
76. What abnormality is usually found in the pleural cavity when a subphrenic abscess is present beneath?
77. Is exploratory puncture for a subdiaphragmatic abscess safe? When may it be made; when is it contraindicated?
78. What is meant by the expression "negative pressure aspirating needle?"
79. What is a subphrenic pyopneumothorax?
80. What is meant by the gas bubble of subphrenic abscess? Its origin? Frequency?
81. Give a differentiation between an empyema and a subphrenic abscess.
82. Classify subphrenic abscesses. Give usual causes for these abscesses. Why is the history of paramount importance?
83. What are the signs and symptoms of subdiaphragmatic abscess?
84. Give the roentgen-ray evidence which points to subphrenic abscess.
85. What is eventration of the diaphragm?

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# The American Journal of Surgery

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FEBRUARY, 1930

No. 2

## CONDUCTION ANESTHESIA FOR MINOR SURGERY\*

GEORGE P. PITKIN, M.D., F.A.C.S.

BERGENFIELD, N. J.

IT IS interesting if not instructive to know that in 1915 there were ten articles published in the American medical literature on local, conduction and spinal anesthesia. In 1920 there were twenty-three contributions. In 1929 one hundred twenty-two articles were published by American authors. During the same year European physicians contributed more than twice this amount. For the most part these articles had been written by and for the specialist. There has been little or no attempt made to describe a simplified technic that could be readily understood by the general practitioner.

There were three medical colleges in the United States teaching local and conduction anesthesia in 1920. This may explain to some extent why this form of anesthesia is not more generally used by the profession. In fact the majority of general practitioners have little or no conception of the dosage, advantages, or technical use of novocaine anesthesia. This is well exemplified by the answers obtained from questionnaires sent to several hundred physicians in country practice, without hospital associations, with the inquiry: "How many cubic centimeters of a 1 per cent novocaine solution would you consider it safe to inject into a patient weighing 150 pounds." Two hundred four replies were received: A trifle over 50 per cent of the physicians were kind enough to answer. Of these 63 per cent considered 2 to 4 c.c. a maximum dose. Sixteen per cent thought it

safe to use from 2 to 10 c.c.; 8 per cent would use from 5 to 15 c.c.; 6 per cent not over 20 c.c.; 3 per cent up to 30 c.c. One replied "use enough." These replies demonstrated quite conclusively that a vast majority of the practicing physicians of the country have not had adequate training in this branch of anesthesia, either during their college course or their hospital internship; especially, when one considers that Babcock, Farr, Lowsley, Jones and the author have repeatedly used 400 to 500, and even 600 c.c. of a 1 per cent novocaine solution without causing untoward effects, and in none of the cases were toxic symptoms observed.

Local and conduction anesthesia is very rapidly becoming the anesthetic of choice, as is shown not only by the increasing number of articles that are written each year, but by the fact that in 1908, 2 pounds of novocaine were sold in the United States, and at present there is a consumption of approximately 2000 pounds a week. Practically every university hospital in the United States is now using routinely some form of local or spinal anesthesia, whereas in 1920 the technic was taught in three of our colleges.

For some unknown reason local and conduction anesthesia has been looked upon as a highly specialized art, far too technical and dangerous to be practiced by the untrained. Possibly this conception regarding the relatively small dose of 2 to 6 c.c. was due to the fact that the only available source of novocaine solution

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was the dentist's ampule. If the physician had obtained adequate instruction in his college course or practical training during

ryngeal obstructions, or the obese, when a safer method is available?

Should patients be subjected to the

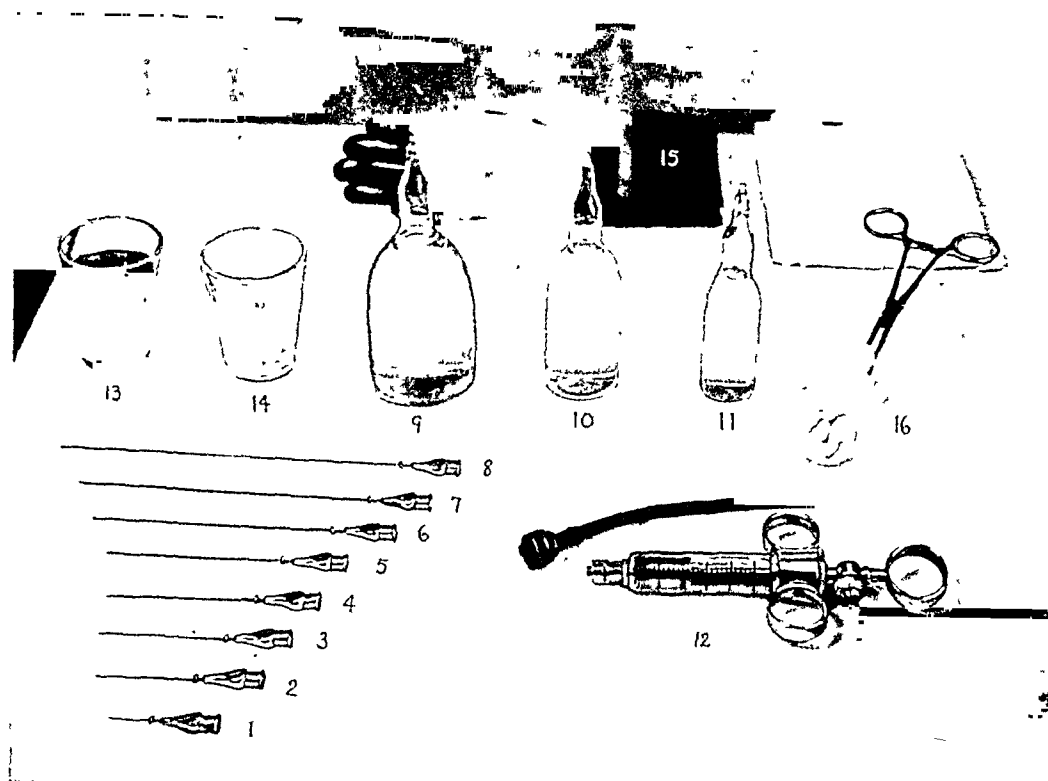


FIG. 1. Table set up with essentials for conduction anesthesia. 1, needle  $\frac{3}{4}$  inch 25 gauge; 2,  $1\frac{1}{2}$  inch 22 gauge; 3, needle 2 inch 22 gauge; 4, needle  $2\frac{1}{2}$  inch 22 gauge; 5, needle 3 inch 22 gauge; 6, needle 4 inch 22 gauge; 7, needle 5 inch 22 gauge; 8, needle 6 inch 22 gauge. 9, 10 and 11, 100 c.c., 50 c.c., and 25 c.c. ampules of novocaine solution. 12, Pitkin continuous flow syringe. 13, Iodine solution. 14, Alcohol. 15, Gloves. 16, Gauze and sponge holder.

his internship, he would not have regarded the technic as being highly specialized, but instead would have been familiar with its relative simplicity.

We are obligated to our patients by virtue of their confidence in us to resort to every known means to protect their lives to the best of our ability. Are we worthy of that confidence when we deliberately expose them to the possibilities of ether pneumonia, lung abscesses, shock and gas distention, ileus or acute dilatation of the heart or stomach? Are we adhering to the implied law when we give any form of inhalation narcosis to a cardiac, nephritic, drug addict, alcoholic or asthmatic patient, to those suffering with eclampsia, diabetes, hypertension, arteriosclerosis, decompensation of the heart, pleurisy, pha-

many dangers of inhalation narcosis? Should they be compelled to bear the added financial burden of general anesthesia? Should they be hospitalized or compelled to remain in bed following ether anesthesia? Should tubercular patients be subjected to the possibilities of a fatal pneumonia, or should the profession at large familiarize themselves with a safer, more effectual and more economical form of anesthesia than the ether cone?

The technic of conduction anesthesia has been so simplified, so modernized and the anesthetic solution so safely prepared that there would seem to be no possible excuse for using ether anesthesia in minor surgery. Conduction anesthesia enjoys undisputed advantages over

other forms of analgesia or general narcosis, in that the patient does not have to be prepared before administration. In fact

their preanesthetic state. It is more economical than any form of inhalation anesthesia. This resolves itself into only one

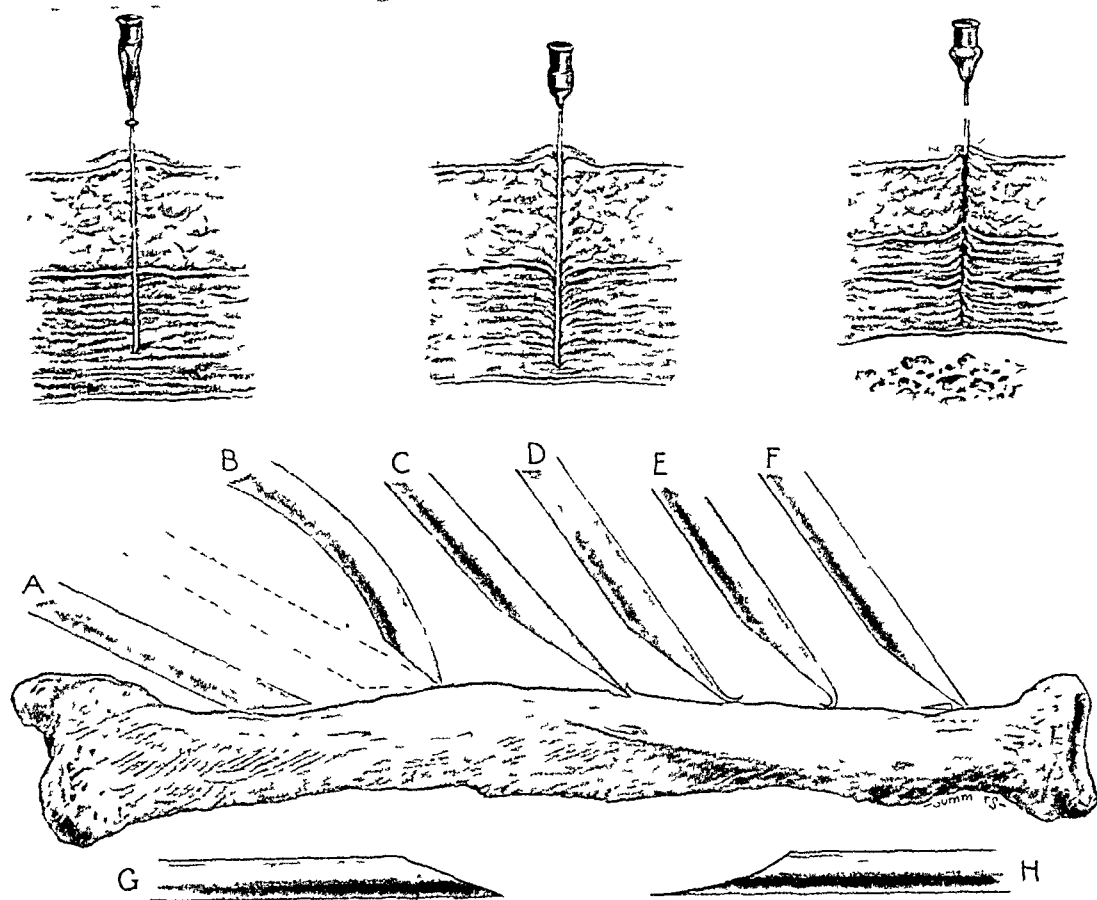


FIG. 2. Upper left: Sharp needle does not tear or traumatize tissues. Upper center: dull needle forced into body causes mutilation and trauma of tissues. Upper right: needle point has been bent. When it is withdrawn tissues are torn. A short beveled needle (A) may be glided over bony surfaces. If the point (B) catches in the bone it will not break. The long beveled needle (C) may cut or penetrate the periosteum, or the point may become bent (D, E) or broken (F). The short beveled needle (G) is preferable for deep injections, to the long beveled needle (H).

it is better to give the anesthetic after a hearty meal. There is no postoperative gastrointestinal disturbance. It eliminates the dread of general anesthesia. Many patients fear the anesthesia more than they do the operation. Shock is not increased by its use; by adding ephedrine shock may be more or less overcome. Arrested tubercular cases are not converted into active ones. Active cases are not subjected to the dangers of fatal lung complications. It may be administered to asthmatics, nephritics, and those suffering with heart lesions, without altering

logical conclusion that the physician or surgeon who in this day and age is not prepared to give certain patients conduction anesthesia is inefficient to the extent of denying his patients something to which they are justly entitled, namely the safest anesthetic.

The advantages of conduction analgesia are many and those of the profession who are familiar with its use look upon it as the safest form of anesthesia we possess for all major or minor surgical procedures with a possible exception of local.

The operator may administer it himself,

a distinct advantage to the country physician, to the industrial surgeon and in emergency cases.

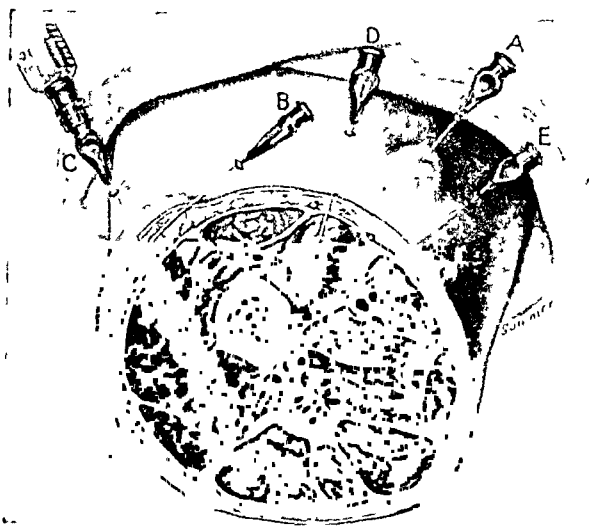


FIG. 3. Intradermal wheal is made with a 25-27 gauge needle (A). Subdermal wheal (A) is raised by causing needle point to penetrate skin from within. Subcutaneous wheal is produced by injecting anesthetic solution in tissues close to skin (needle B). By projecting novocaine solution ahead of needle C, injection is not painful. Injecting solution so that it anesthetizes tissues at side of needle D does not eliminate pain. Pain is produced when needle E is inserted into tissues.

It is more economical to the surgeon, because expensive and cumbersome apparatus is unnecessary; to the patient, as the anesthetist's fee may be saved.

It permits cooperation of the patient, a marked advantage when one is working without assistants in the home or office.

There is no paralysis of the anesthetized field. The patient is able to move, turn or adjust his position to help the surgeon in his work.

Convalescence is shortened and in many cases the patient may be permitted to go home at once. Hospitalization is unnecessary.

The anatomy is not distorted as with local anesthesia. There is no edema of the operative field. The possibility of secondary hemorrhage is lessened. It may be used to anesthetize infected or inflamed fields without fear of contaminating healthy tissues.

Postanesthetic nausea, vomiting, distention or suppression is seldom observed.

No postanesthetic complications follow its use as pneumonia, bronchitis, lung abscesses, etc. Therefore, it is more desirable for the emaciated or aged patient.

It may be administered to patients with inflammatory lesions of the respiratory tract without fear.

Patients do not have to be prepared for the anesthetic.

Conduction anesthesia blocks all afferent nerves. Painful impulses are not transmitted, result no shock.

For fractures and dislocations one experiences a greater relaxation than with any other anesthesia, with the possible exception of deep ether narcosis.

With its use patients suffer less post-operative pain.

It produces no change in the blood chemistry or metabolic rate.

It does not produce or increase diacetic acid or acetone in the urine. Acidosis does not have to be combated.

It is safer than general anesthesia when deep prolonged anesthesia is necessary. Morbidity is eliminated.

The primary and secondary anesthetic mortality becomes nil.

The duration of anesthesia may be regulated according to the amount of the vasoconstrictor agent.

Regular diet may be given at once.

The contraindications of conduction anesthesia are few and as one becomes more familiar with the technic the contraindications become less and less. Children under the age of ten or twelve years might be looked upon as undesirable subjects, but it is remarkable what can be accomplished with these little patients if one will have a little patience. A bottle for infants and candy or toys for the older children will so deviate the attention of the child that the operative procedure may be carried out without interference.

Syphilitics, epileptics, insane or neurotic subjects are looked upon as undesirable for this form of anesthesia. It produces no ill-effect in a luetic, and we never make exception to these cases. We do invariably

eliminate the epileptics, not because we have reason to believe that the anesthetic would in any way affect the patient, but strictly to a few general technical rules. Gain the patient's confidence, promise that you will not hurt him and then keep

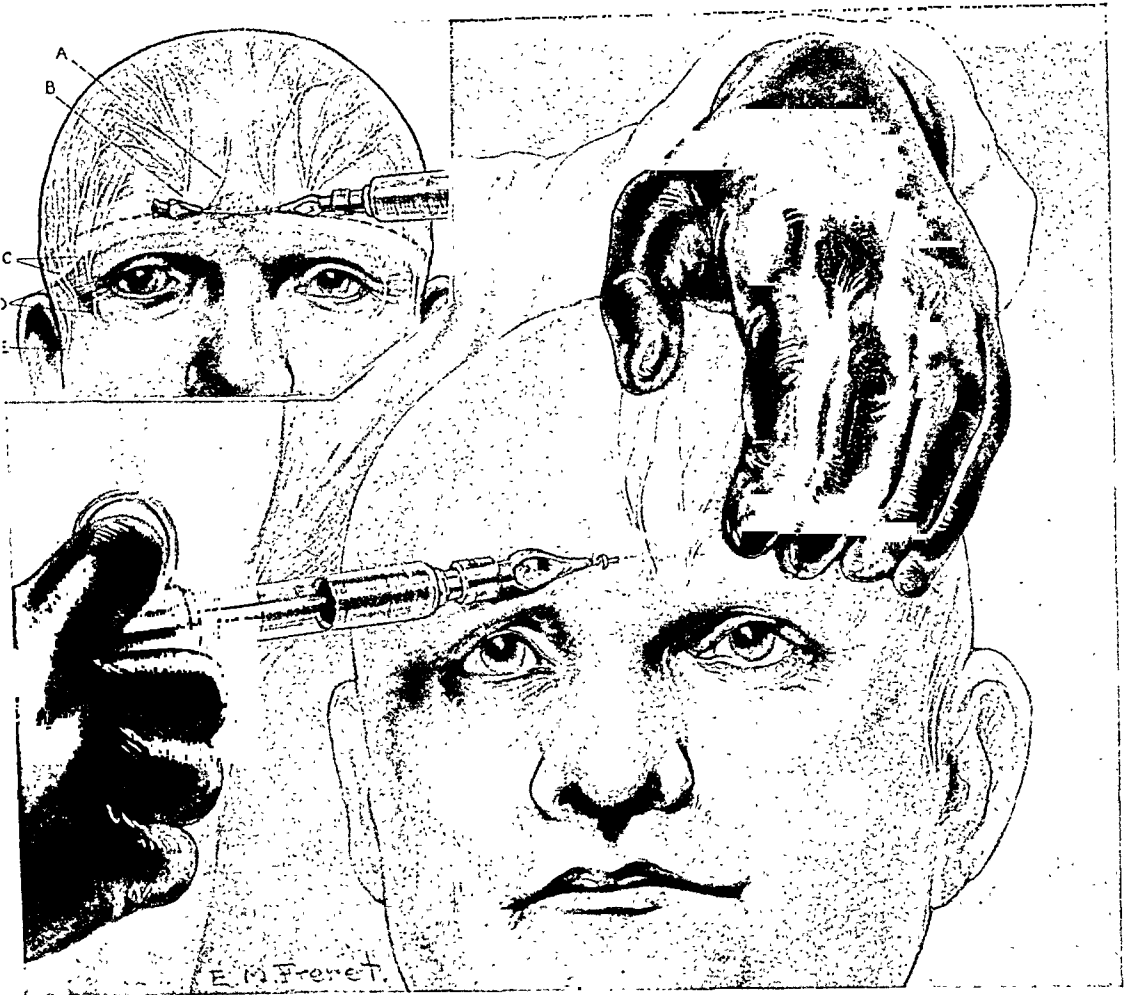


FIG. 4. Needle being guided around frontal bone by finger tips of left hand. Insert shows method of anesthetizing entire frontal region from primary central wheal.

because we are fearful of a convulsion during the operation.

Conduction and spinal have been the anesthetics of choice in the State Hospital at Greystone Park for the past two years. The results have been very gratifying. If the neurotic patient cannot be controlled by the preliminary use of morphine and scopolamine, or if there is reason to believe that due to their nervous state they will attribute their future real or imaginary ailments to the anesthetic it will be advisable to use inhalation narcosis.

To experience the gratifying results that are possible in surgery with this form of anesthesia one should adhere

your word. Patients once hurt may not only lose confidence in the method but the doctor. A patient who is subjected to one painful manipulation becomes over-apprehensive to all following procedures. A confidence once lost is hard to regain and may be the direct cause of an unsuccessful anesthesia.

Conduction anesthesia demands a simplified, thorough and skillful technic. When due consideration is given to the minute details the operator will be satisfied and the patient grateful. A knowledge of the anatomic parts, bony landmarks, location of nerves, deep and cutaneous, is essential. Some idea of the anatomical

relations may be had from the accompanying illustrations.

Strict surgical aseptic technic must be

advancing the thumb in the plunger ring faster than the point of the needle travels.

To obtain the desired results with con-

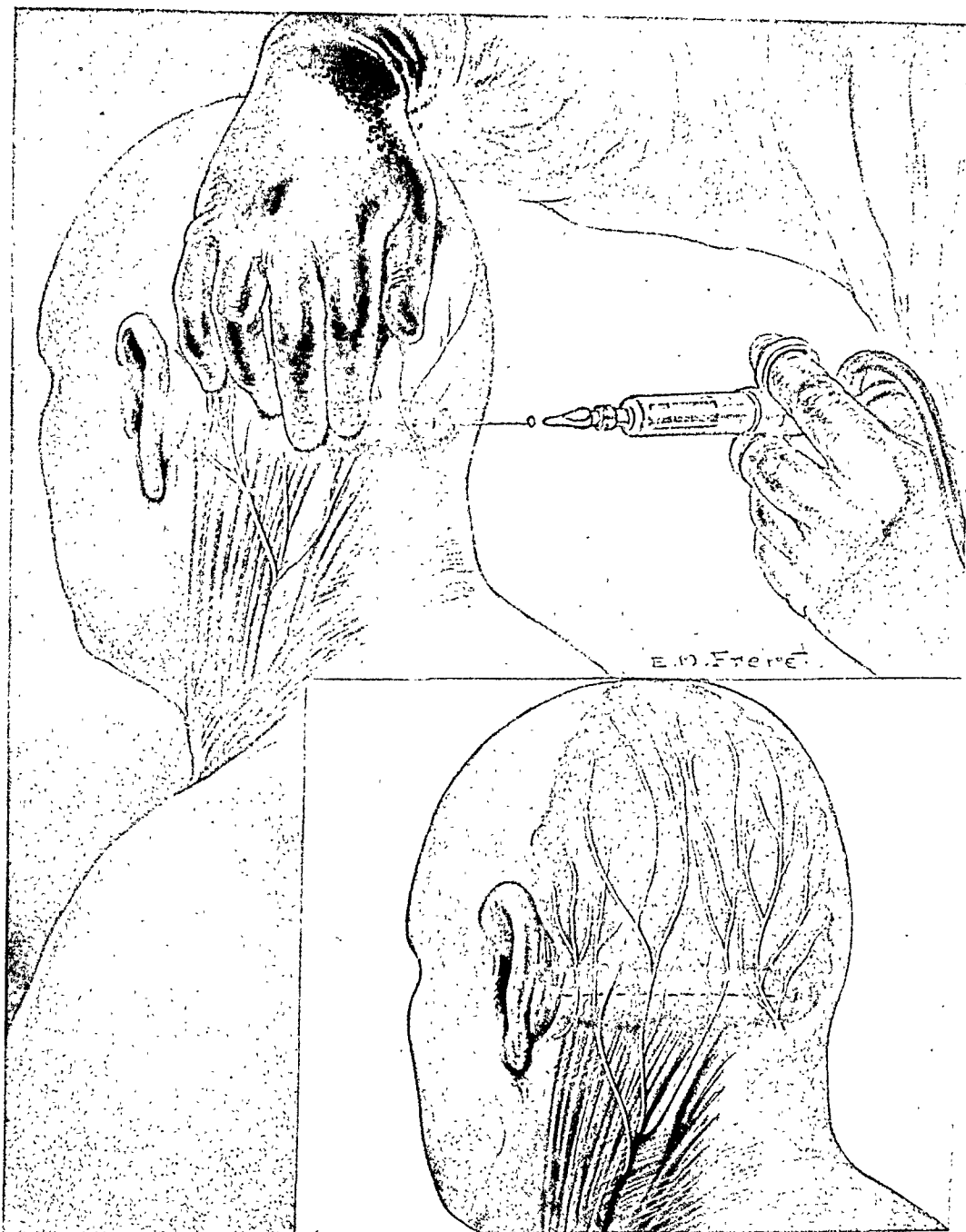


FIG. 5. Needle is inserted through scalp over external occipital protuberance. Point is guided through subcutaneous tissue by finger tips. Insert shows subcutaneous wheal, nerve supply and region anesthetized.

observed. To avoid pain never insert a needle into the tissues unless it is attached to the syringe. Always endeavor to project the anesthetic solution ahead of the needle (Fig. 3, c). This is easily accomplished by

duction or local anesthesia it is essential to have proper syringes, needles and a dependable anesthetic solution of known strength. If one is to use any old syringe or a needle of a large calibre that is rusted

or dull, or a solution that is not stable or discolored, the strength of which is questionable, and the amount of vasoconstrictor sterilized by boiling, because the piston and barrel have the same coefficient to heat.

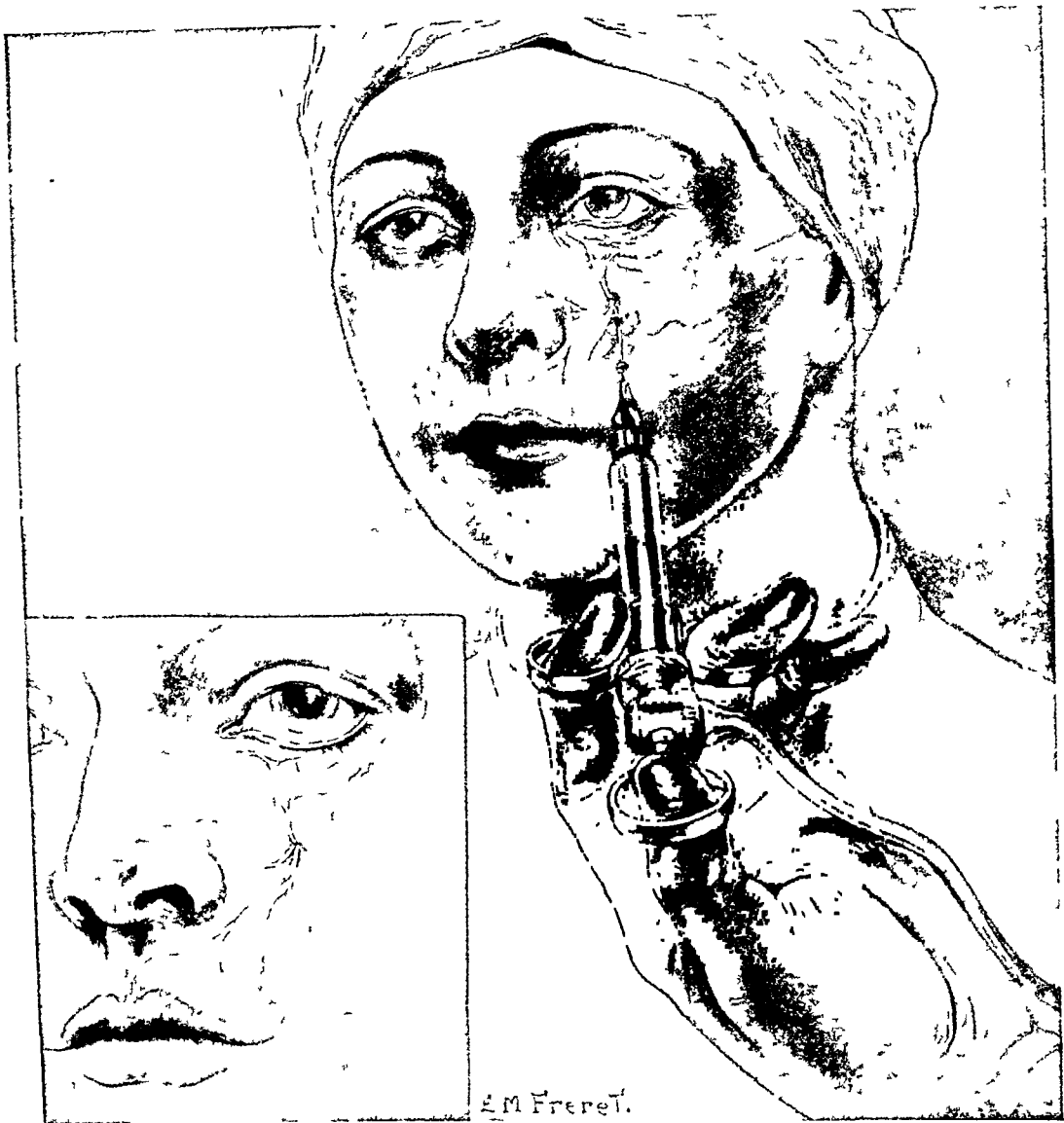


FIG. 6. Method of anesthetizing infra-orbital nerve. Insert shows nerve distribution, shaded region represents field of anesthesia.

agent uncertain, the results will be so unsatisfactory that in all probability a good method will be abandoned before the technic is mastered. Therefore, I would suggest:

A syringe similar to the author's, a continuous flow instrument, which will permit the injection of the anesthetic agent without detaching it from the needle.

It does not have to be dismantled to be

It contains no unsanitary packing washers or threads.

It is equipped with a locking device that prevents the needle from "blowing off."

The construction is such that there are no working parts to get out of order, with the exception of a small inexpensive rubber valve.

The plunger and barrel are accurately ground which prevents leaking and elimi-

nates sticking of the piston or breaking of the barrel. tip end of the syringe. This prevents the possibility of "pushing off" the end of the syringe.

It is so constructed that it may be

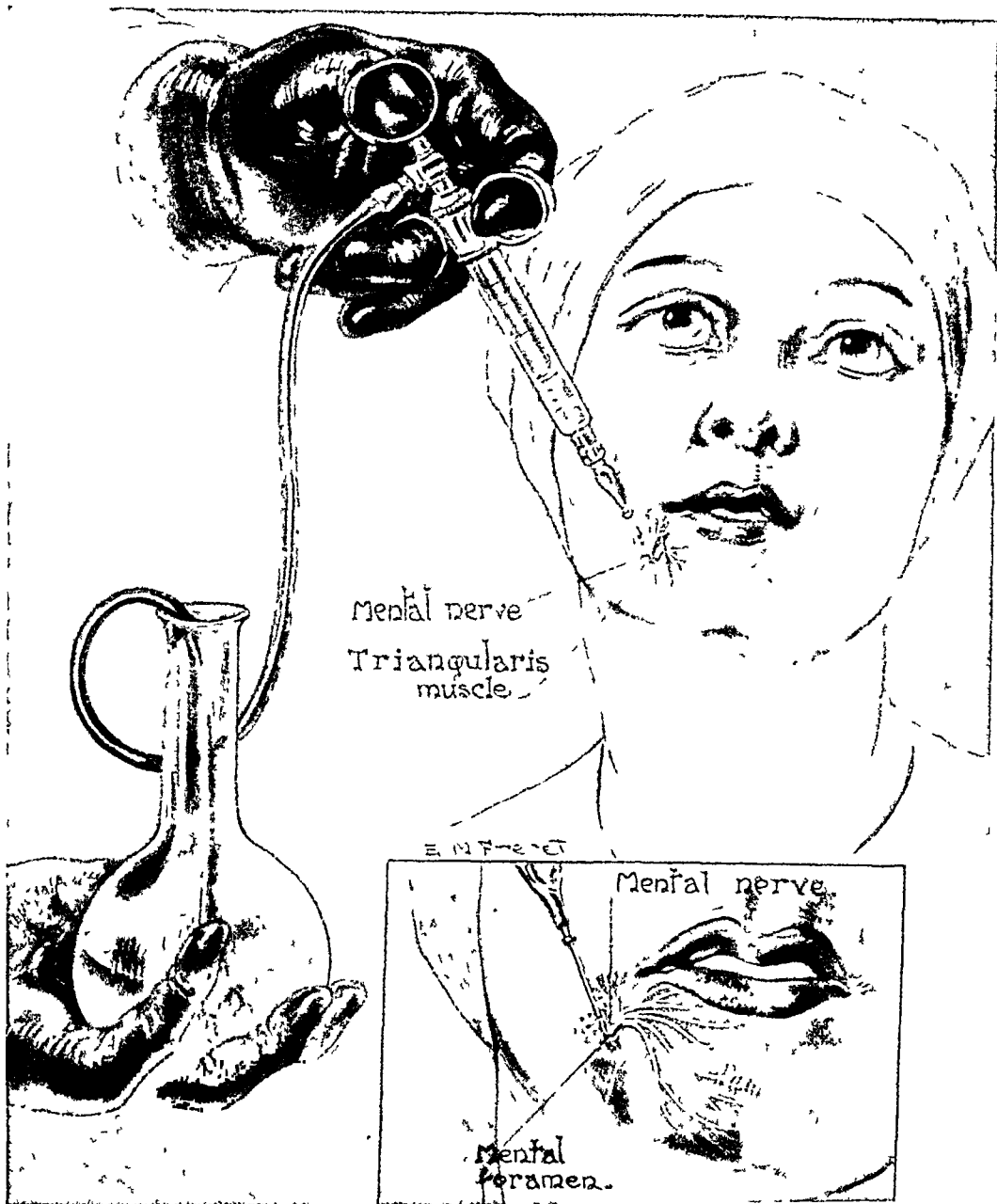


FIG. 7. To anesthetize mental nerve one should endeavor to visualize location of needle point. Foramen is usually found midway between alveolar processes and lower border of jaw, over apex of second bicuspid. Shaded portion of insert shows field of anesthesia.

easily used with one hand, a 5 c.c. capacity accurately graduated. It is equipped with comfortable finger rings that do not cut or hurt the hand.

There is a metal collar on the piston stem that permits the piston to approximate but not come in contact with the

It is so constructed that it may be refilled by withdrawing the plunger. A small valve at the side of the piston stem controls the flow, and as the piston is advanced the solution is injected into the tissues. It is worked not unlike a pump. Should the tip of the needle be within a

vein when the piston is withdrawn blood will appear in the barrel of the syringe which warns the operator that the needle

The needles are the result of three years' alloy experimentation. They will not rust or corrode.

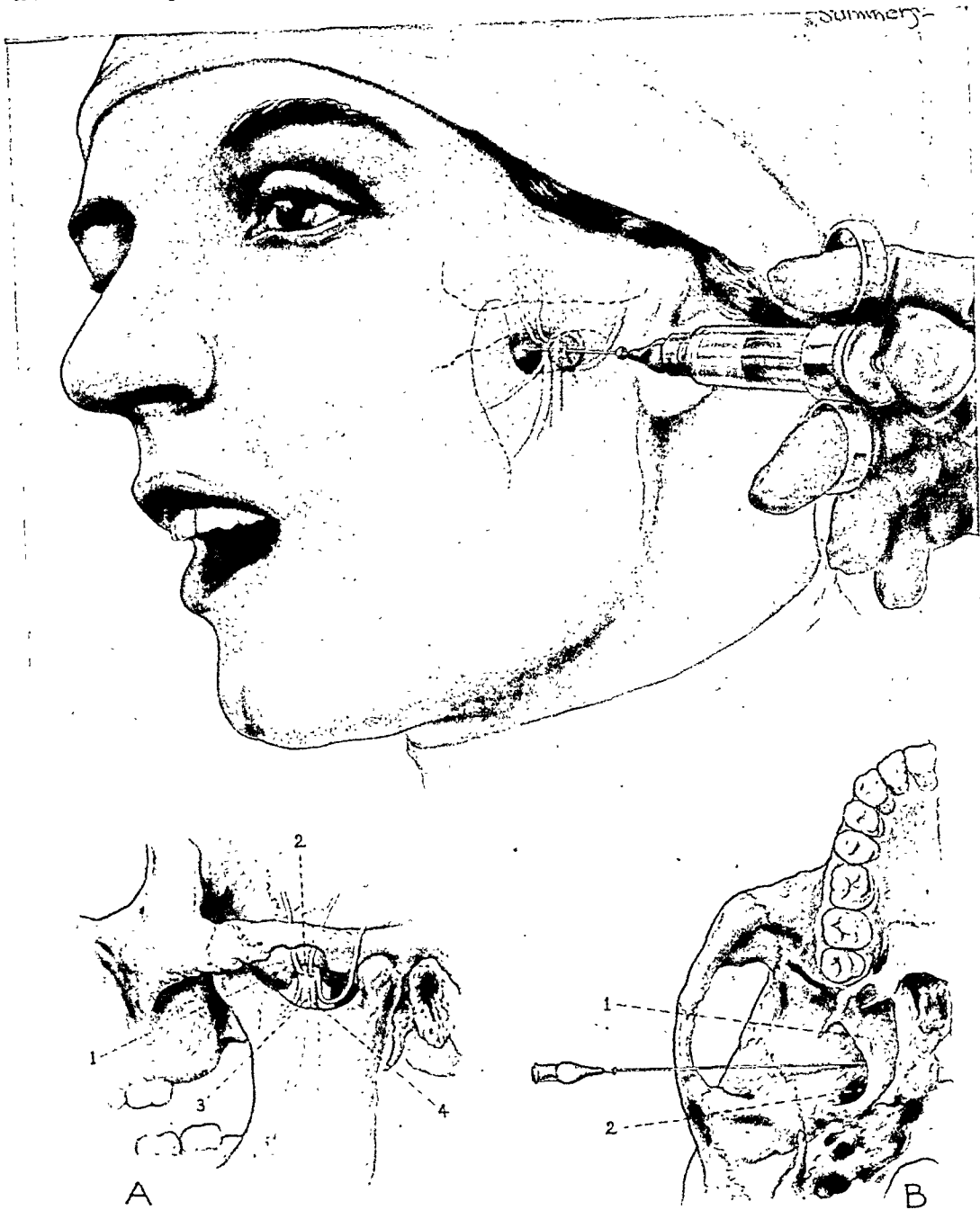


FIG. 8. Anesthetizing mental, lingual, buccal, auriculotemporal and deep temporal nerves by injecting zygomatic fossa. Inset A indicates (1) where needle approaches wing of sphenoid in close apposition to (3) lingual, (4) mental nerves, as they emerge from foramen ovale. Inset B: looking into zygomatic fossa from below, (1) sphenoid plate, (2) foramen ovale.

point is in a vein and the injection should not be made.

It permits of the injection of large amounts of solution in a comparatively short time without removing the needle from the tissues or detaching the syringe.

They are not affected by iodine or ordinary acids.

They are very tough, and will withstand a great deal of bending and manipulation before they will break.

They are equipped with a safety guard,



which prevents them from becoming lost in the tissues should they be accidentally broken.

The temper is sufficient to maintain a sharp point for a long time.

Their flexibility is such that they may

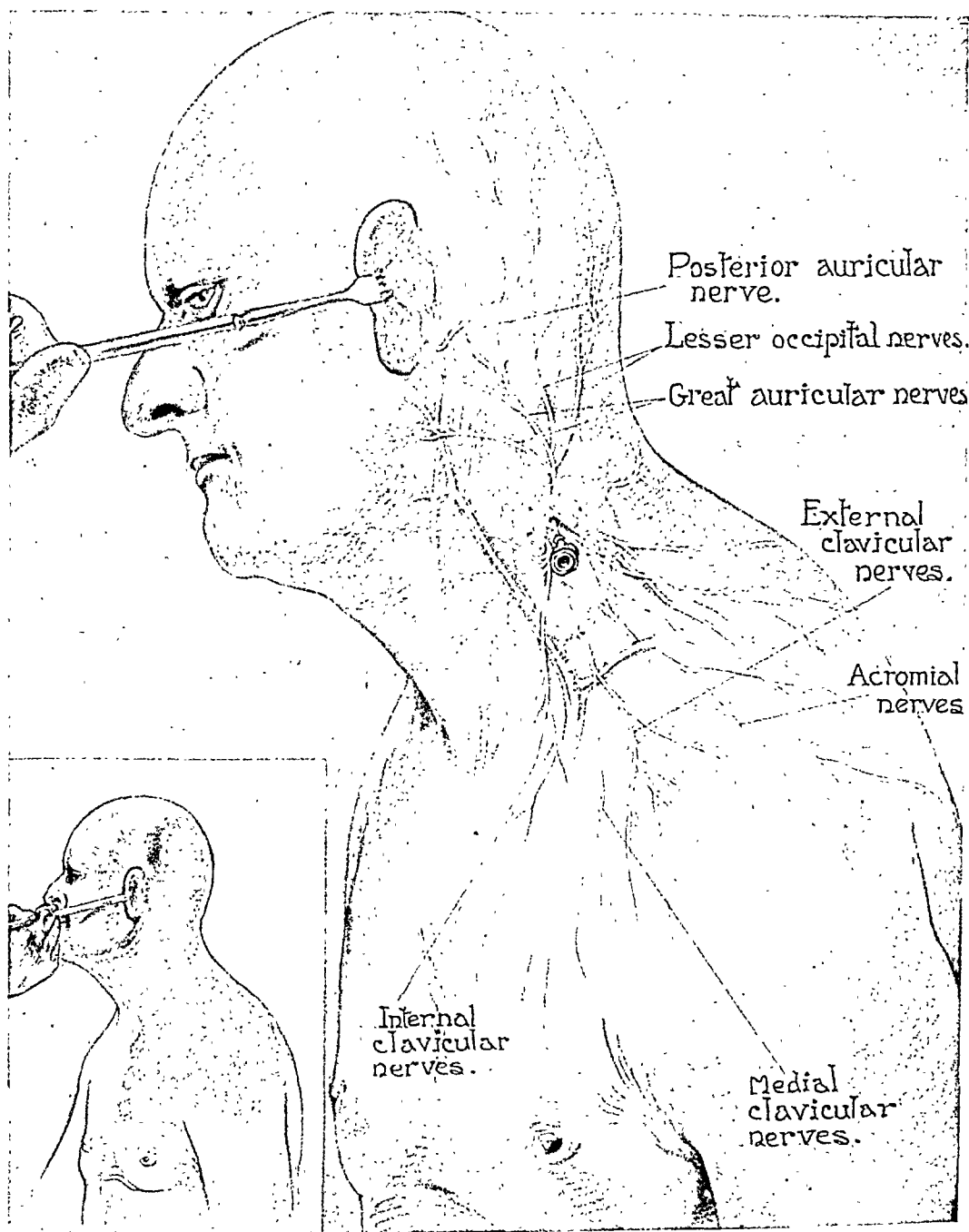


FIG. 9. Ten c.c. of a 1 per cent novocaine solution has been injected under posterior border of sternocleidomastoid muscle, to anesthetize branches of superficial cervical plexus. Cutaneous field of anesthesia is shown in insert.

They may be sterilized for emergency work in a flame. Apparently they have all of the advantages of a platinum instrument at the cost of a steel needle.

be guided in the tissues or around a limb without fear of breaking, and due to this flexible feature large fields may be anesthetized through one puncture wound.

It eliminates the necessity of making a human pin cushion of a patient.

It is inadvisable to use the ordinary

with a bone it may be bent (Fig. 2), and when it is withdrawn tear the tissues, or the tip may be broken and remain as a foreign

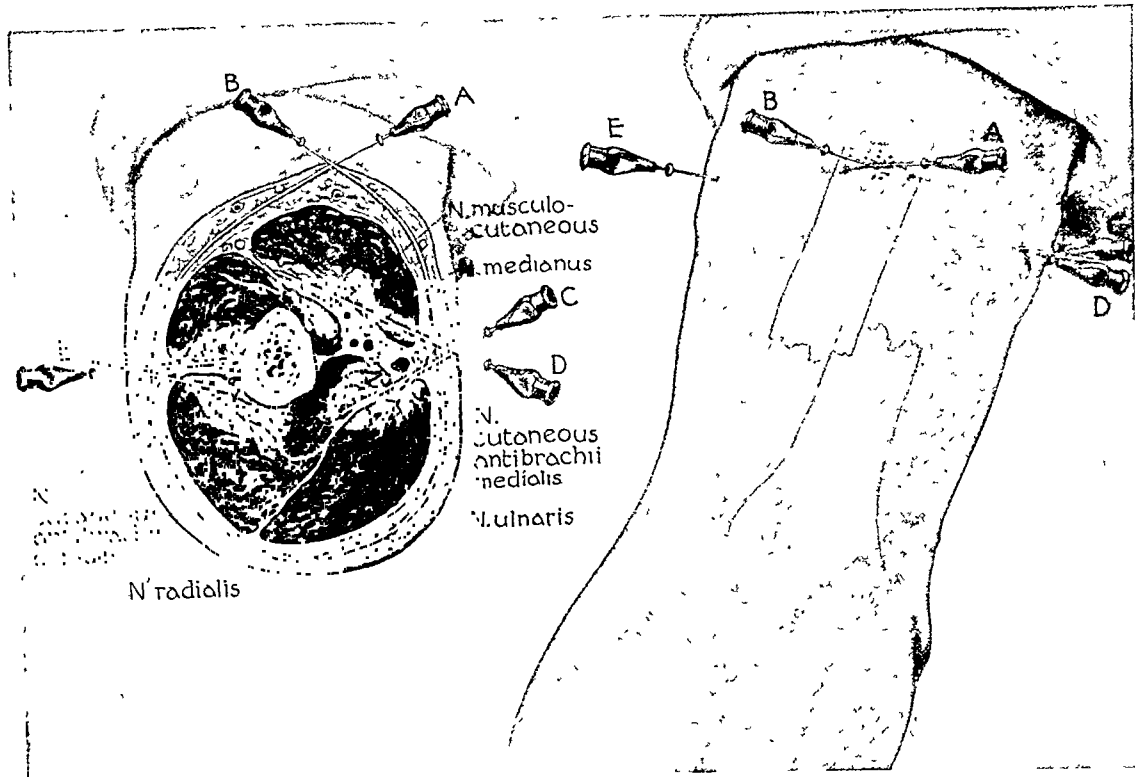


FIG. 10. Method of producing anesthesia of mid arm. Needles A and B are introduced through interdermal wheal to raise subcutaneous wheal. Needles C, D, and E are used to anesthetize deep nerves, as seen in cross section.

steel or nickeloid needle for conduction anesthesia because side pressure cannot be applied without fear of breakage. They become hard and brittle with frequent boilings and break easily. Steel needles rust and corrode. It is as painful to inject a rusty needle as it is to pass a rusty sound into the urethra. Nickeloid needles are not hard enough to maintain a sharp point. They are so brittle that a larger gauge wire is necessary to assure strength.

The wire of a needle should be as small as possible for the particular use to which it is to be adopted. It is never advisable to use a needle larger than a 22 gauge. Large needles or dull needles so traumatize the tissues that they produce pain not only at the time of insertion, but painful sensations due to the injury of the tissues sometimes last for several days. It is inadvisable to use a long-bevel needle for deep injections because if the point comes in contact

body. A short-bevel needle may be glided over or around a bone with ease.

It is advisable to use a needle with a short bevel for deep injections because the point will not bend or break should it come in contact with a bone. If the angle of approach is sufficiently acute the rear of the bevel will make contact with the bone, which permits gliding over the periosteum without tearing or penetrating it. A short-beveled instrument may be controlled and guided in the tissues with greater ease. There is less danger of the point bending or breaking. Should the point of the needle break one will find it is a very difficult task to find and remove the foreign body.

It is always advisable to test the needles before they are sterilized. The longer needles are grasped at the hub between the thumb and finger and the point held in the same manner with the other hand,

and thus bent into a semicircle. The shorter needles are tested by placing the point against the thumb nail and applying

cannot be expected with a preparation of this nature. In the past it has been rather difficult to prepare large amounts of

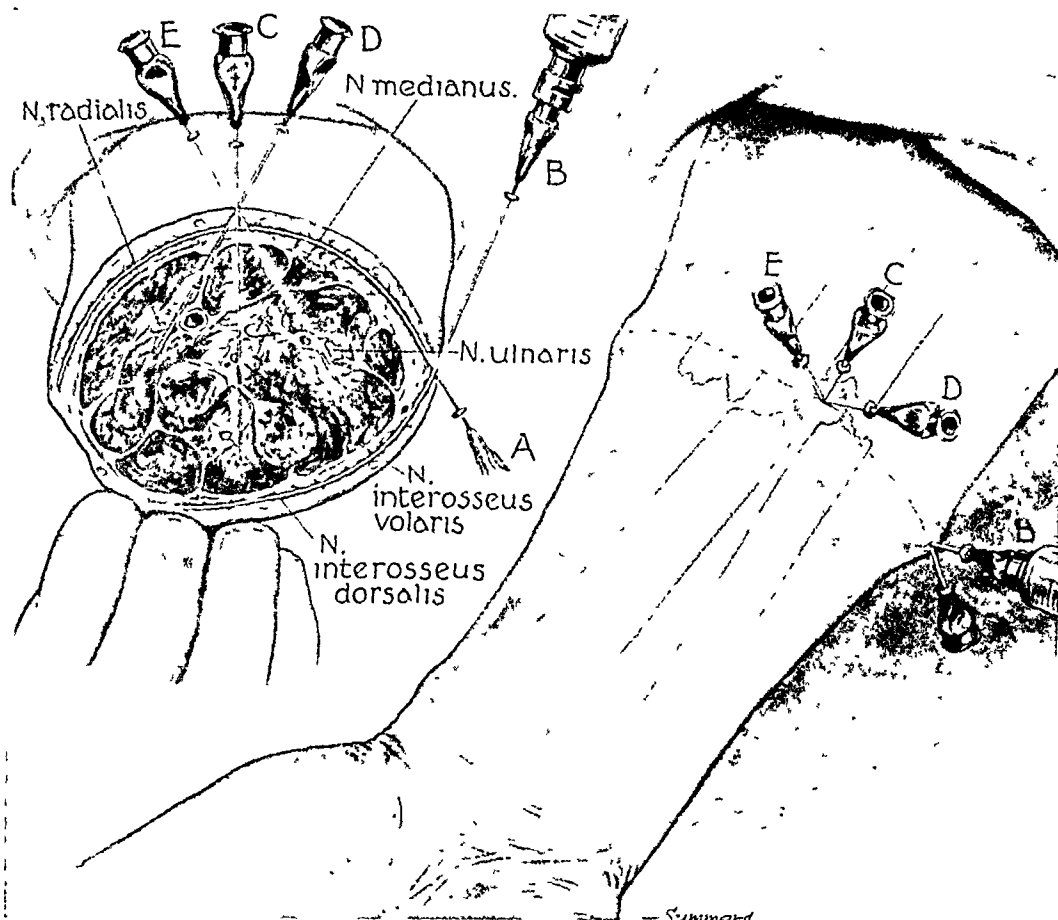


FIG. 111. Due to difference in contour of a forearm primary wheal is raised laterally and needle A is carried around anterior surface of arm; while needle B is guided by finger tips through subcutaneous tissue to meet end of subcutaneous wheal produced by needle A. Deep nerves are easily anesthetized from central point of introduction on anterior surface of arm.

a moderate amount of lateral pressure. If they are defective it is better to have them break at this time than in the tissues of the patient.

The anesthetic solution should be sterile, staple, and water white, containing a known percentage of novocaine and a definite amount of the vasoconstrictor agent to maintain anesthesia for a definite time. Pink or brownish solutions should not be used. The pink color indicates that the adrenalin is oxidizing, the yellow or brownish solution signifies either that the vasoconstrictor agent has become oxidized, that the solution is stale, or has been oversterilized. The desired results

novocaine solution in the home or office from the crystals, and if one required 100 c.c. of a 1 per cent novocaine solution it would necessitate approximately one hour's time to prepare it, due to the fact that the normal saline would have to be sterilized, the novocaine weighed, and dissolved in the saline, resterilized, cooled and then the vasoconstrictor agent added. This inconvenience and the consumption of time of a busy physician may explain to a great extent why this form of anesthesia is not more generally used in the home or office. One can readily see how impractical its use would be in the home.

To overcome this inconvenience and

place at the disposal of the profession a sterile, staple solution, ready for instantaneous use, the author has had

ephedrine ampules are prepared for use in patients suffering from a hypothyroid condition, as it must be remembered

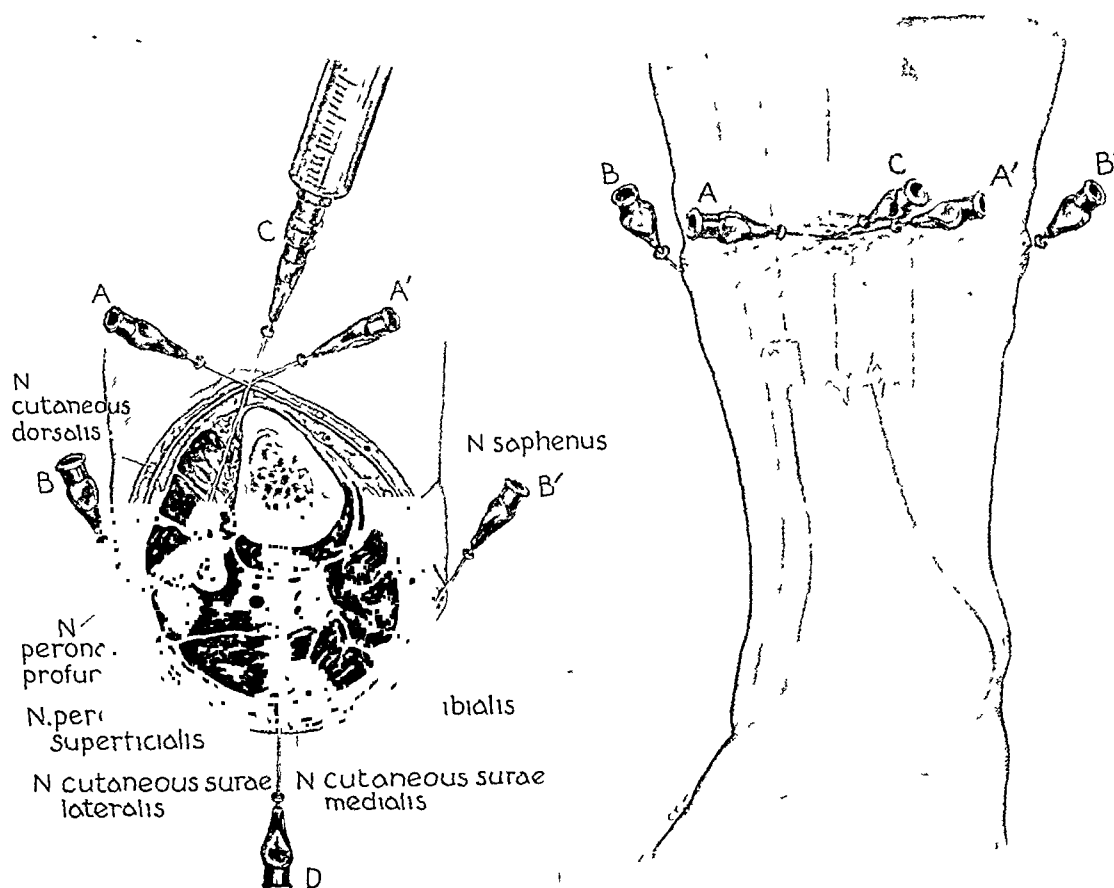


FIG. 12. Should it be impossible to guide needles A and A' around leg, subdermal wheals are raised and needles B and B' complete wheal. Deep nerves are anesthetized by needles C and D.

prepared ampules of 25, 50 and 100 c.c. capacity with the following formulae:

1. Novocaine 1 gm.  
Isotonic solvent 100 c.c.
2. Novocaine 1 gm.  
Suprarenin .0005 mg.  
Isotonic solvent 100 c.c.
3. Novocaine 1 gm.  
Ephedrine .050 mg.  
Isotonic solvent 100 c.c.

These ampules are sterilized by emersion in alcohol. The neck is broken and the sinker of the continuous flow syringe inserted into the solution. No other container is necessary. The plain novocaine preparation is sufficient only for anesthesia of short duration. The solution containing the suprarenin will maintain satisfactory anesthesia for two to three hours. The

that these patients cannot tolerate adrenalin or any of its derivatives. To be on the safe side any patient with a pulse rate of over 110 should have the ephedrine solution in preference to the one containing suprarenin, to avoid the possible convulsions that may follow the injection of the synthetic adrenalin preparation into a hyperthyroid patient.

If too great a concentration of suprarenin or adrenalin is used the tissues will be tender and possibly inflamed for two or three days after its use. The patient may complain of a headache and blame his condition upon the anesthetic. It is not an infrequent occurrence to have a patient inform you that they cannot tolerate novocaine as it poisons their system. This

idea is perhaps derived from the dentist's local anesthesia, as they invariably use 1:50,000 adrenalin concentration, some-

will not hurt him. Now let's keep our word. Attach a 25 gauge  $\frac{3}{4}$  inch needle to the syringe, expel the air from the

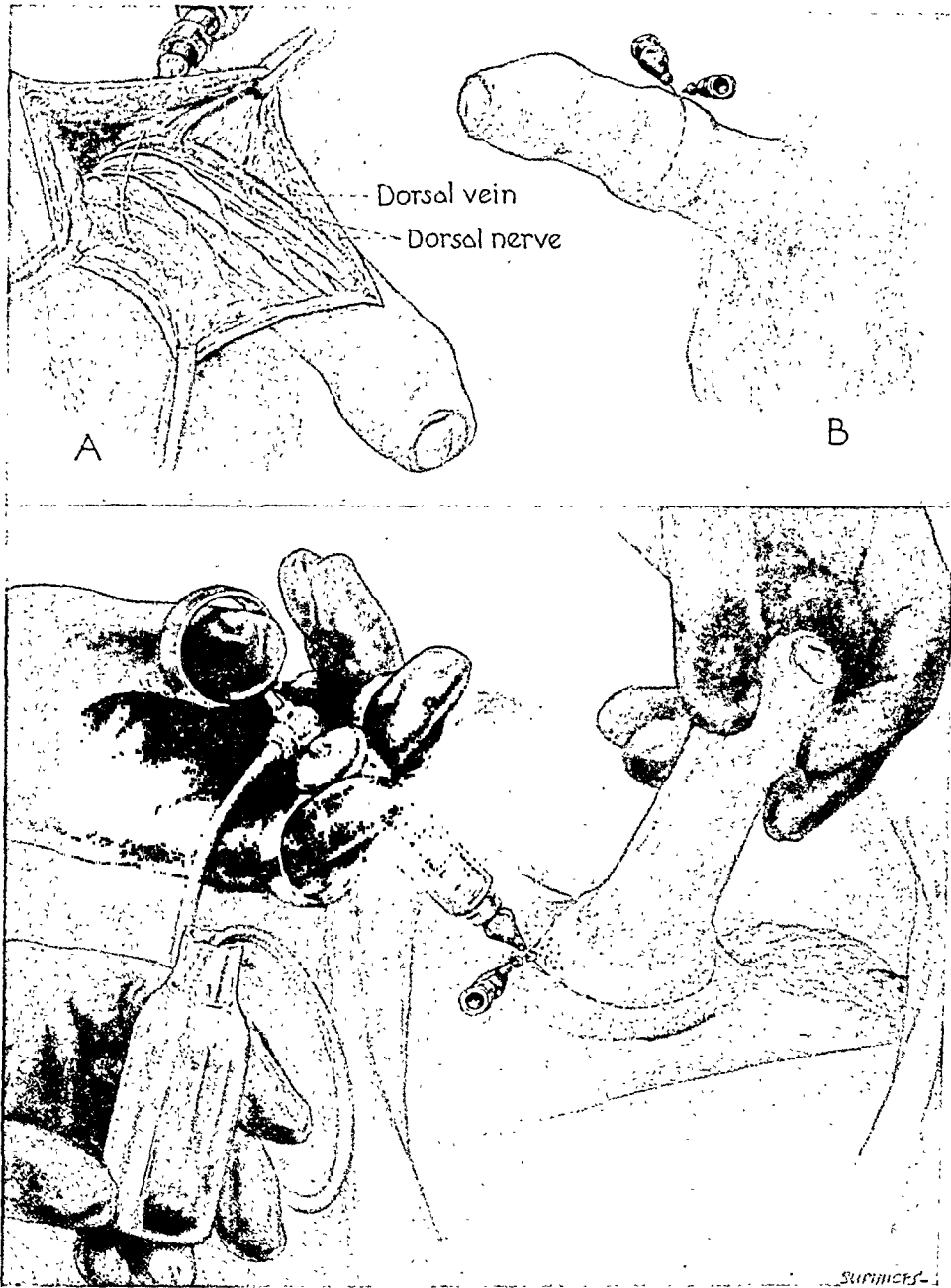


Fig. 13. Method of inserting curved needle around base of penis. Inset A shows needle passing over dorsal vein in close apposition to branches of dorsal nerve. Inset B illustrates method of producing anesthesia for circumcision.

times 1:25,000, and we all know the headache and soreness of the gums that follow its use. The solution already described is a 1:500,000 suprarenin concentration and will not leave any after-effects.

We have promised the patient that we

syringe and supply tube by slowly working the piston back and forth. At the site of the initial injection raise a wheal (Fig. 3 A) the size of your finger nail. The syringe and needle are held at an angle of approximately  $20^\circ$  to the skin. With the point

of the needle lying at the site of the intended wheal, with the skin grasped between the thumb and finger of the left

the original wheal (Fig. 3 D) by the use of 4, 5 or 6 inch needles. If these are to be continued over a greater distance than

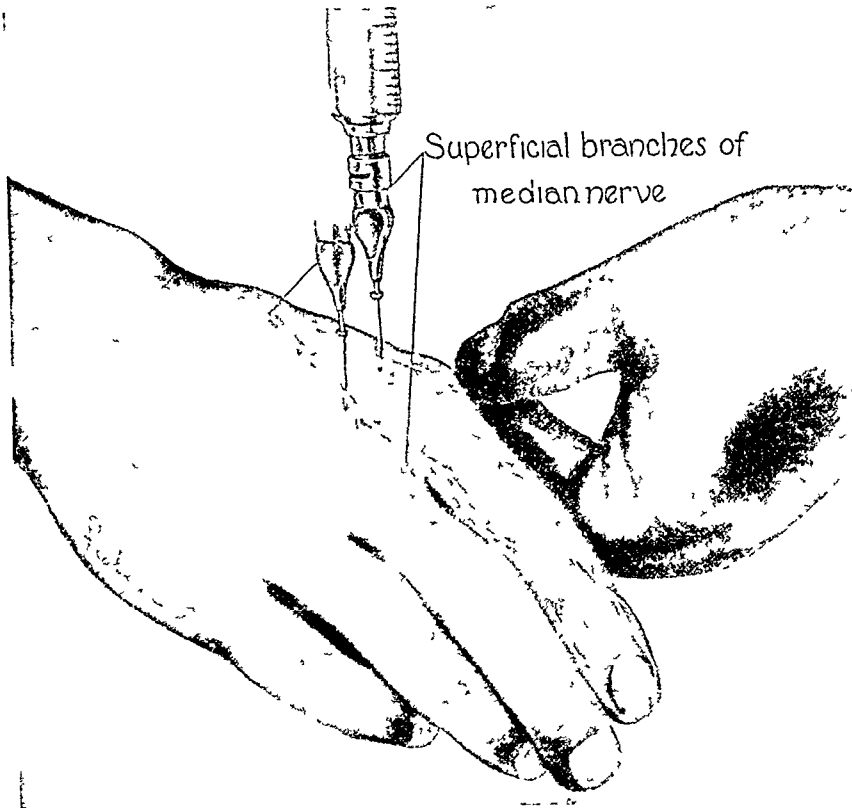


FIG. 14. Operator's fingers are placed in palm of patient's hand to prevent needles penetrating palmar skin.

hand, or stretched in the opposite direction by the fingers of the left hand the needle is then introduced with a short, quick, thrust until the bevel has disappeared. Slowly inject a few drops of the solution between the layers of the skin until the wheal of the desired size is raised. If the point of the needle penetrates the true skin the typical wheal cannot be made as the solution is deposited into the subcutaneous tissues. The wheal may be made with little or no pain and anesthesia is produced instantaneously. It is rarely ever necessary to raise more than one intradermal wheal for a field. Should subsequent wheals be desired raise them subdermally (Fig. 3 A). Never attempt to produce an intradermal wheal on the plantar surface of the feet, the palmar side of the hand, or the scalp. Subcutaneous wheals may be made several inches from

the length of the needle a subdermal wheal may be raised by pressing the skin with the finger in advance of the needle point, thus causing the point of the needle to penetrate the skin from within. (Fig. 3 A). The flexible needles advocated will permit one to carry the subcutaneous wheal about the arm or leg from the site of the initial insertion (Fig. 3 B), thus anesthetizing all of the subcutaneous nerves in the region. Two to 4 c.c. of solution should be injected for each inch infiltrated, the amount depending upon the region of the body and thickness of the fatty tissues. Satisfactory anesthesia may be obtained with much less solution in thin individuals.

After the wheal has been made never insert a needle for deep injections unless it is attached to the syringe (Fig. 3 E) as this is an extremely painful manipulation.

When a needle is introduced into the tissues project the solution ahead of the needle as it advances (Fig. 3 c). This bony landmarks. When nerves are located in the soft tissues and one does not have definite landmarks as a guide, satisfactory

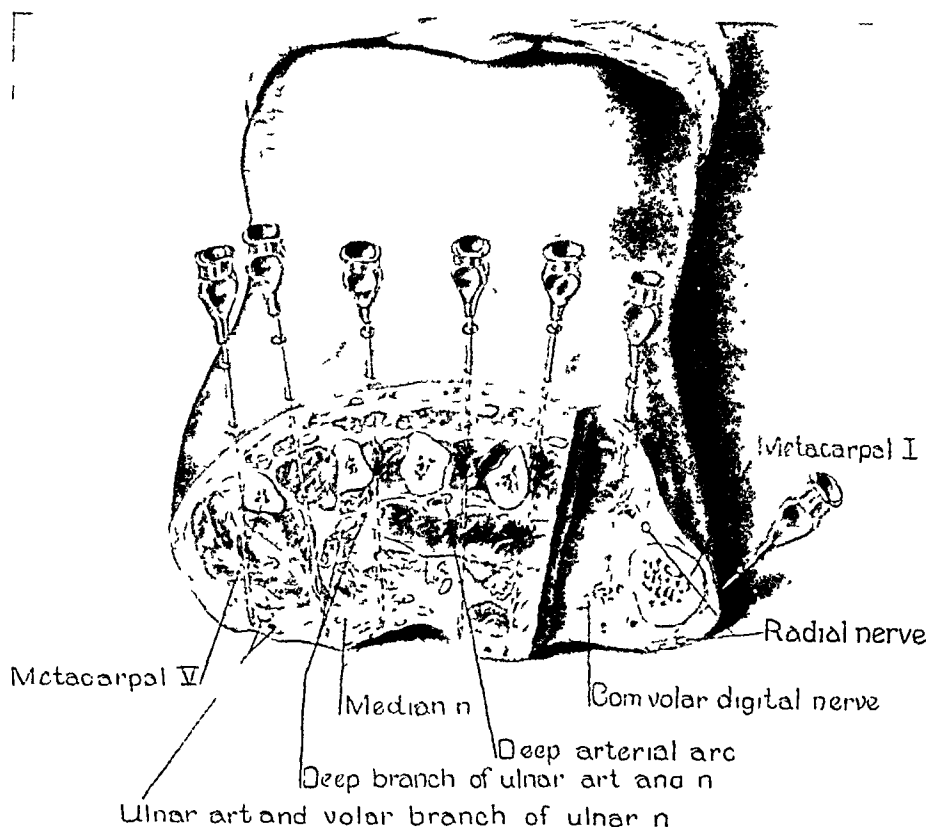


FIG. 15. Cross section of hand showing manner in which needles are introduced between metacarpal bones. Solution is projected through needles as they advance. Needle is then withdrawn to skin surface and reintroduced at an angle that would approach palmar surface, at same point that needle used to anesthetize previous interosseous space stopped.

procedure will not cause pain. Do not insert the needle and inject the solution in such a manner that it will infiltrate the tissues about the side of the needle as this will not eliminate painful sensations.

The superficial or cutaneous nerves are anesthetized with comparative ease. When definite cutaneous regions are to be made insensible to pain it is of course essential to be familiar with nerve supply, and one should know where and how to approach the supplying nerve trunks. To anesthetize the deep nerves satisfactorily an accurate knowledge of their location is required. The operator should not only be familiar with the exact location of the nerve trunks, but he should have a knowledge of their relationship to definite

results may be expected only with practice and experience.

One must bear in mind that the intensity and time required for complete anesthesia of a region will depend upon the skill and training of the physician, the size of the nerve trunk and the quantity and strength of the anesthetic solution injected. One should endeavor to so perfect his technic that satisfactory anesthesia may be secured with relatively small amounts of solution rather than use large quantities. If the tissues of the arm or leg are infiltrated sufficiently anesthesia of course will occur in the distal parts, but this again is approaching local anesthesia, which we are desirous of avoiding. It is our object to anesthetize the afferent

nerves and this may be best accomplished by injecting the solution as near the nerve trunk as possible.

the anesthesia, but relieves the psychic reaction.

The space allotted to this article will

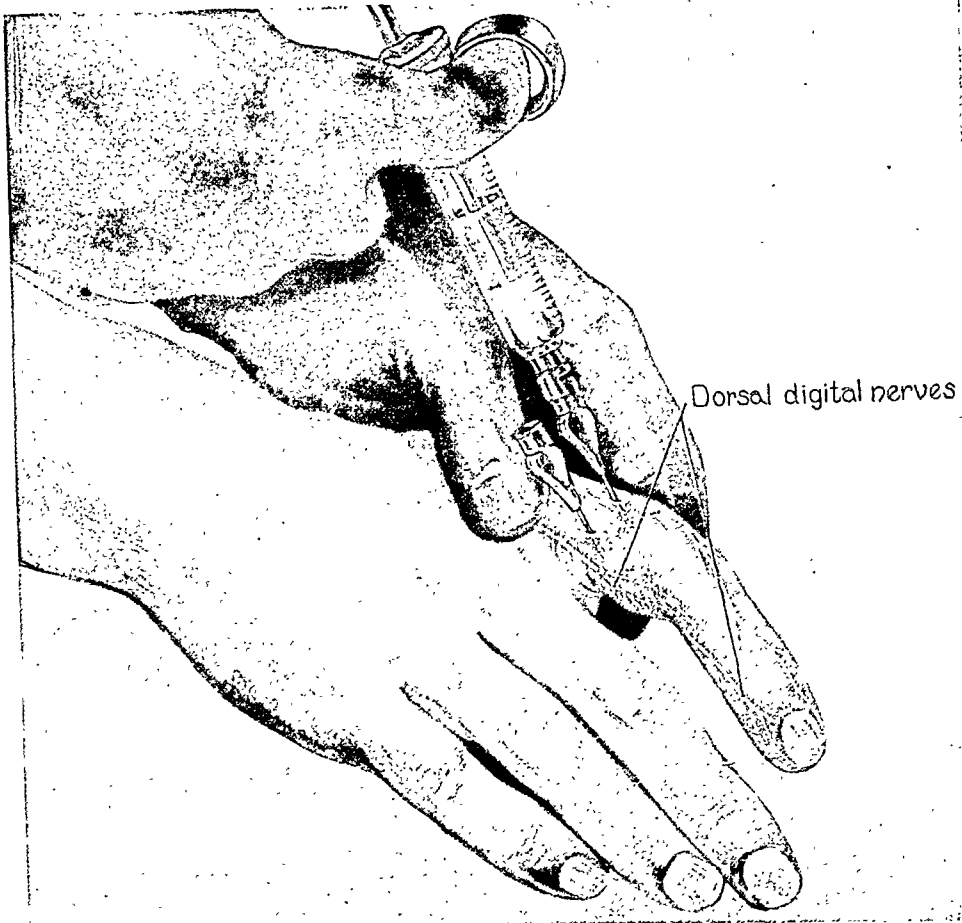


FIG. 16. Anesthetic solution is deposited close to bone. Location of anterior and posterior nerves should be kept in mind and a greater amount of solution deposited about location of nerves.

Ordinarily a 1 per cent novocaine solution is sufficient for most anesthetics. Large nerve trunks or those situated deep within the tissues may be more quickly anesthetized with a 2 per cent preparation. Usually satisfactory anesthesia of the smaller nerves occurs within five to seven minutes if the proper technic has been employed. Should there be no anesthesia after ten to fifteen minutes a second injection may be made without fear. The patient will rarely if ever require any premedication for the ordinary minor surgical procedure. The fears of a nervous individual may be allayed by a preliminary hypodermic of morphine sulphate 0.016 mg. and scopolamine 0.0004 mg. This does not intensify

not permit a complete and accurate anatomical description of the nerve supply, neither will it suffice to describe the minute details of technic as completely as the author desires. Therefore, we must rely upon illustrations to help us exemplify the technical procedures. It has been said that one illustration will convey as much knowledge as 500 words of text. This being so, we may be able to convey our ideas by using a sufficient number of drawings.

The frontal and temporal frontal region of the scalp from the orbital eminence to the vertex is supplied by the frontal, supraorbital, zygomatic, temporal and the auricular temporal nerves, all branches of the trigeminal. These are easily anesthet-



ized by raising a wheal midway between the superciliary arcs. Then attach a 5 or 6 inch 22 gauge flexible needle to the syringe.

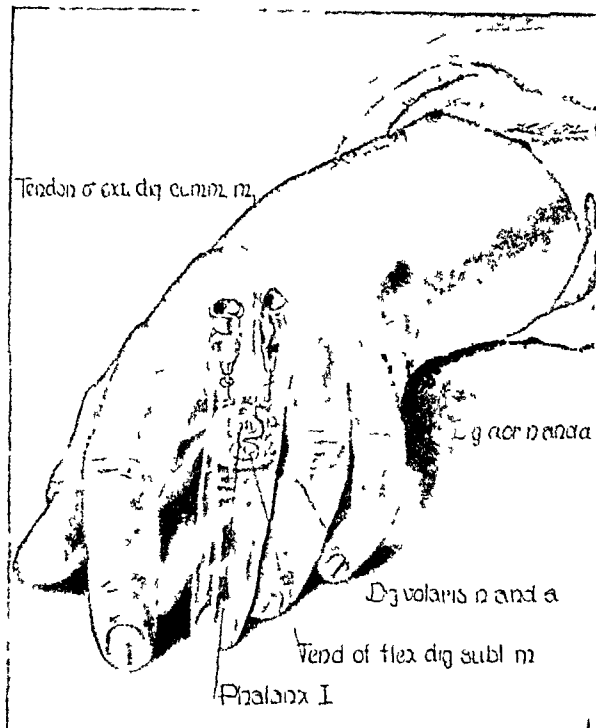


FIG. 17. Cross section of finger illustrating location of nerves, relation of needles to bone and nerves. Original contour of finger is preserved by transparency.

The needle is introduced through the center of the wheal at right angles to the skin until the periosteum is felt. Two to 3 c.c. of the anesthetic solution are injected. The needle and the syringe are then carried to the side so that the shaft of the needle lies in close apposition to the skin surface pointing toward the upper part of the ear of the side to be anesthetized. The needle is then rotated so that the arrow on the hub is upward toward the vertex. This would indicate that the bevel is pointing toward the patient's face. As the needle is advanced 1 to 1.5 c.c. of solution is projected into the tissues for each centimeter of tissue penetrated. This produces an edema of the tissues and causes the skin to become elevated, increasing the depth of the subcutaneous space. The needle is easily guided through the edematous tissue with the finger tips of the left

hand (Fig. 4). Fifteen to 20 c.c. of solution will produce satisfactory anesthesia in the adult. Should anesthesia of the entire frontal region be desired withdraw the needle point to the skin surface. It is then pointed in the opposite direction (inset, Fig. 4) when the operator proceeds as before. Should one be fortunate enough to be ambidextrous this procedure is relatively simple. It is unnecessary to do a field block of the frontal region making several punctures of the scalp completely about the region to be operated upon, as all of the afferent nerves of the entire frontal region are completely anesthetized from the one central point. This method affords satisfactory anesthesia for the removal of sebaceous cysts, birth marks, or suturing the scalp. If the nerves have been cut or torn at the time the laceration was produced the skin surface distally has no painful sensations. Should the nerves be intact they are anesthetized, again demonstrating that it is not necessary to surround the lesion with a field of novocaine solution.

The occipitoparietal and posterior temporal regions are supplied by the greater and lesser occipital and posterior auricular nerves. The great occipital is a branch of the second cervical; the lesser occipital and posterior auricular are branches of the second and third cervicals. To anesthetize these a 25 gauge needle is attached to the syringe and inserted through the scalp down to the bone over the external occipital protuberance. Inject 2 to 3 c.c. of a 1 per cent novocaine solution, which raises a subcutaneous wheal, then attach a 6 inch needle, introduce this through the subcutaneous wheal, carry it to the side so that the shaft of the needle approaches the scalp surface, pointing towards the upper portion of the ear, and project the novocaine solution, 1 c.c. for each centimeter of tissue penetrated. The needle is guided around the skull (Fig. 5) by the finger tips of the opposite hand. Should the needle penetrate the pericranium and be caught in the bone it is slightly withdrawn and advanced with less pressure by

the finger tips. Should the needle begin to penetrate the scalp more solution is injected to produce a greater edema, which

Patients rarely if ever complain of any pain with this form of anesthesia, but occasionally where a Martell trephine

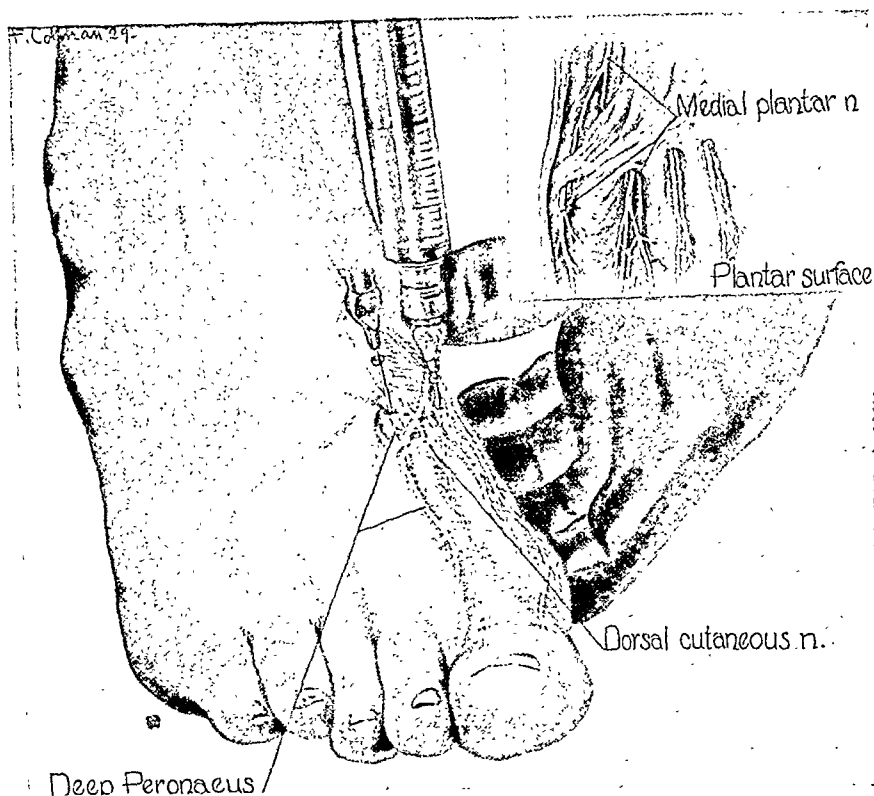


FIG. 18. Method of anesthetizing tissues about first metatarsal bone for bunion operation. Note position of operator's fingers on sole of foot. Insert shows relation of needle points to plantar nerves, as needle approaches sole of foot.

will elevate the scalp from the cranium and increase the thickness of the fascia. It is then slightly withdrawn and guided along the superior linea nuchae as before until the subcutaneous wheal extends from the occipital protuberance to the ear (Fig. 5). When anesthesia is desired of both sides of the occipital and the right and left temporal parietal regions the needle point is withdrawn to, but not from the skin surface. It is then carried to the opposite side and the injection made as before. This suffices to anesthetize the occipitoparietal and posterior temporal regions for any minor surgical procedure that may be required.

By using two primary sites of injection (Figs. 4, 5) the entire skin fascia, pericranium and cranium may be anesthetized, which will suffice for major operative procedures on or within the cranium.

is used they will mention that they feel a sensation of heat, which would indicate that thermal sensations have not been entirely obliterated.

Minor surgical operations may be performed upon the lower lid, the anterior portion of the face adjacent to the nose, the alae of the nose or the upper lip by anesthetizing the infraorbital nerve. Lip operations invariably necessitate the injection of both right and left infraorbital foraminae. The needle is introduced through a wheal in the cheek directly below the pupil about 2 cm. below the orbital margin. Ordinarily the foramen may be palpated through the cheek. If this is possible the procedure is much more easily carried out. If it is impossible to palpate the foramen accurately the needle should be inserted through the wheal until it reaches bone, and 1 c.c. of the solution

injected. The syringe and needle then should be adjusted so that the point of the needle will be directed towards the needle that is used to raise the wheal may be carried into the tissues for this injection; the foramen should be searched

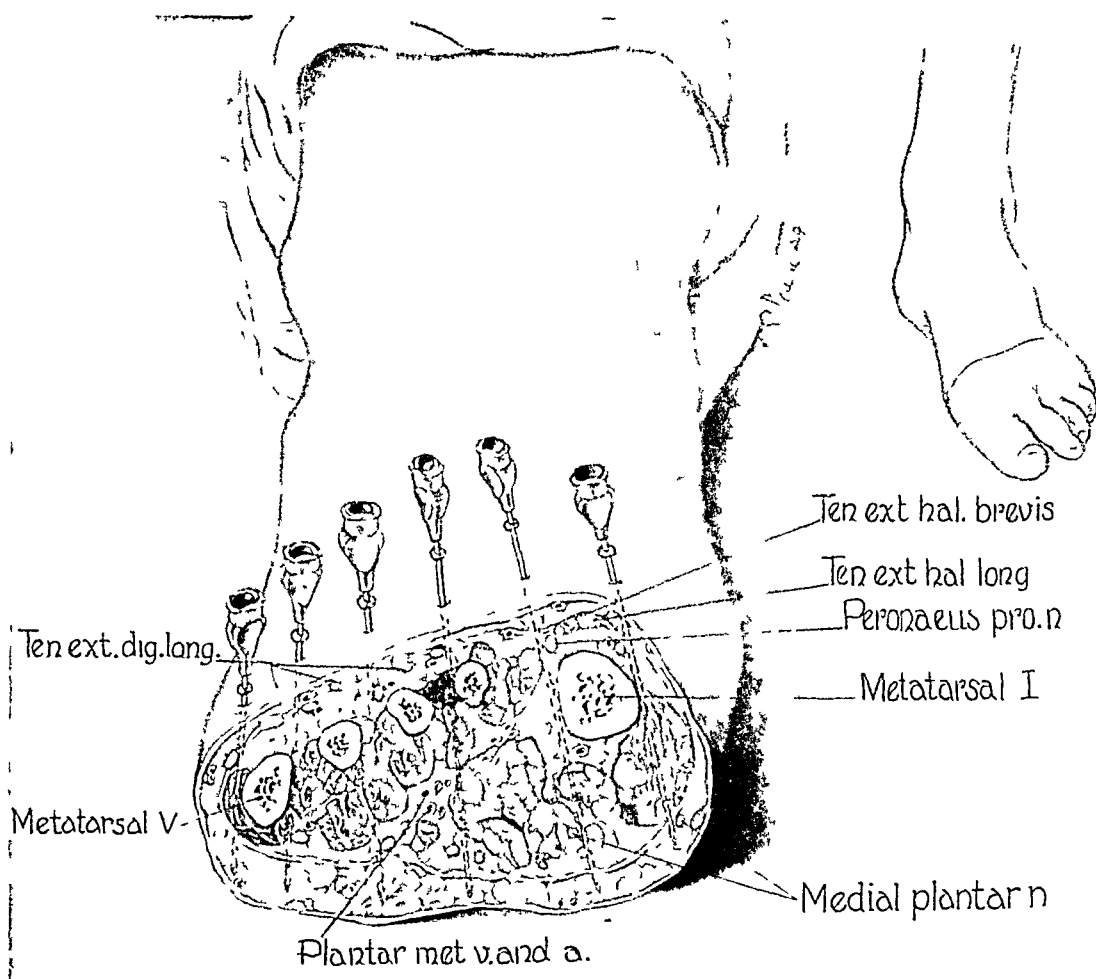


FIG. 19. Cross section of foot showing method of inserting needles through interosseous spaces. Needles are again withdrawn to skin surface and reintroduced, fan-like. Six to 8 c.c. of a 1 per cent novocaine solution are introduced into each interosseous space.

pupil and the supraorbital notch (Fig. 6), with the arrow on the needle facing the operator, then the bevel is directed towards the bone. This will permit the needle's gliding over the bone with ease. The barrel of the syringe should then be over the mental foramen or the second bicuspid. By gently moving the point of the needle upward toward the orbit it will glide into the foramen. The bony wall of the canal will prevent the needle from progressing farther, at which time 1 to 2 c.c. of a 1 per cent novocaine suprarenin solution is injected. The  $\frac{3}{4}$  inch 25 gauge

for with gentle manipulations to avoid pain or the possibility of a broken needle.

This procedure may be also used for injecting the infraorbital nerve with alcohol for localized facial neuralgia. The alcohol solution should not be introduced into the nerve tissue until complete anesthesia has been secured.

Operations on the lower lip, chin, the lower jaw, the incisor teeth or bicuspid may be performed without pain by blocking the mental nerve, which is accomplished by raising a wheal midway between the angle of the mouth and the lower

margin of the mandible, directly over to the apex of the second bicuspid. The needle is then directed downward and

patient opens and closes the mouth the condyle and coronoid processes may be palpated, which will assist materially

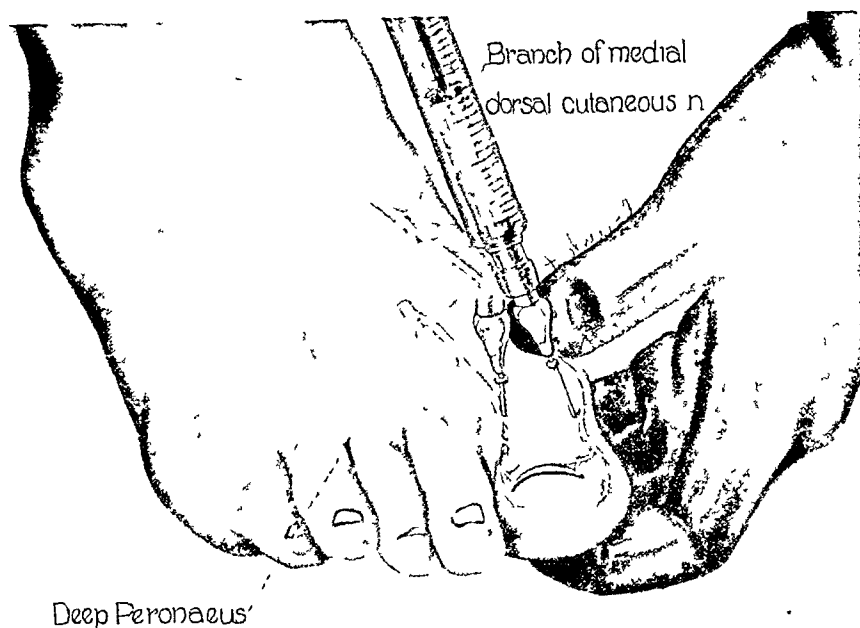


FIG. 20. For removal of toe nail or other operative procedures on great toe anesthesia is produced by depositing 4 to 6 c.c. of a 1 per cent novocaine solution about its base.

forward and advanced until bone is encountered. Inject 1 c.c. of the anesthetic solution before the mental foramen is searched for. This should be found opposite the apex of the second bicuspid midway between the alveolar process and the lower border of the jaw. With the bevel of the needle directed toward the bone it glides into the foramen with comparative ease (Fig. 7). Inject 0.5 to 0.75 c.c. of solution, rotate the needle one-half turn upon its own axis and gently force it deeper into the canal, and inject an equal amount of the anesthetic solution. This will almost instantaneously anesthetize the mental nerve, and the solution that is forced into the canal also produces anesthesia of the nerves supplying the incisor cuspids and bicuspid teeth, also the jaw bone from the bicuspids to the midline.

Operative procedures may also be carried out upon the entire mandible, the lower lip, the tongue or the floor of the mouth by raising a wheal on the skin surface below the inferior border of the zygomatic processes over the sigmoid notch. As the

in locating the sigmoid notch of the ascending ramus. Attach a 2 inch needle to the syringe, insert this at right angles to the skin surface through the center of the wheal previously raised. As the needle is advanced through the skin, connective tissue and masseter muscle, the anesthetic solution should be projected ahead of the needle point. The needle is advanced until the bony resistance of the great wing of the sphenoid is encountered, when 7 to 10 c.c. of solution are slowly injected into the zygomatic fossa (Fig. 8). This bathes the mental, lingual, zygomatic and anterior auricular nerves as they emerge from the foramen ovale. When an operative procedure is to be carried out on the tongue, the floor of the mouth, the anterior portion of the mandible, to the midline of the chin, it is essential that both sides be injected. This procedure is advantageous for the reduction of a dislocated jaw.

It is important that the needle be introduced at right angles to the skin surface to avoid the possibility of the needle

entering the foramen ovale. Should this amount of solution be injected into the extradural space of the middle fossa alarming symptoms might arise. With the proper technic the needle is prevented from advancing farther when the great wing of the sphenoid is encountered.

Anesthesia of the lobe of the ear, the cutaneous and subcutaneous tissues over the mastoid region, the lateral and anterior portions of the neck from the angle of the jaw to the clavicle may be obtained by having the patient rotate the head in the opposite direction from the side to be anesthetized. This will bring into prominence the sternocleidomastoid muscle. Raise a wheal over the posterior border of the muscle midway between the tip of the mastoid and the clavicle; then insert the needle directly inward toward the transverse processes of the cervical vertebrae, for  $\frac{1}{2}$  to  $\frac{3}{4}$  inch, depending upon the thickness of the subcutaneous tissue, and inject 10 c.c. of a 1 per cent novocaine solution. There is little or no danger of penetrating the carotid artery or jugular vein, as these lie well in under the muscle. The point of the needle with the proper technic would be at least  $\frac{3}{4}$  inch from the vessels (Fig. 9). This will anesthetize the occipitalis minor, posterior auricular, superficial cervical, spinal accessory, acromial, outer, middle and internal claviclar, and the suprasternal nerves, which constitute the superficial cervical plexus.

The anesthesia produced is sufficient for any superficial operative procedure on the neck from the lower margin of the jaw to the clavicle. The external ear is completely anesthetized. There is cutaneous anesthesia over the acromial region, and 3 or 4 inches below the clavicle. Superficial cervical glands may be removed with this anesthesia, provided they are not too close to the borders of the jaw, when it becomes necessary to infiltrate along the border of the mandible. This form of anesthesia is preferable to local infiltration for thyroidectomies, but here we are overstepping the bounds of minor surgery.

For the reduction of fractures or dislocations of the hip or femur spinal anesthesia is the anesthetic of choice, but for the arm or leg, conduction anesthesia gives us many undisputed advantages over any form of inhalation narcosis, in that:

We are able to obtain greater relaxation than with any form of anesthesia with the possible exception of deep ether narcosis.

It permits reduction under the fluoroscope without fear of spark explosions, and the operator's work is not hindered or embarrassed by a cumbersome gas-oxygen machine.

The patient is conscious and able to assist in the reduction of a fracture or dislocation.

It does not necessitate the hospitalization of patients. They may be permitted to go home as soon as the splints or caste is applied.

The anesthesia lasts sufficiently long to benumb the parts several hours after reduction. To attempt to describe a technic for all possible fractures that one might encounter would be quite impossible in this short article.

For fractures of the humerus, ulna and radius, or dislocations of the elbow, brachial anesthesia would be preferable, but unfortunately the technic is such that it is not readily understood by all practicing physicians. Therefore, an endeavor will be made to describe methods of anesthetizing parts at or above the site of fracture.

An over-riding fracture of the lower third of the humerus may be reduced by inserting the needle A (Fig. 10) through the wheal raised over the center of the biceps approximately 2 inches above the site of the fracture. This is carried around the arm in the subcutaneous tissue until the point is over the center of the triceps, 1 c.c. of solution being projected ahead of the needle for each centimeter of tissue traversed. The needle is guided by the finger tips of the left hand. The needle point is then withdrawn to the skin

surface and reintroduced in a similar manner as shown by B (Fig. 10). This raises a subcutaneous wheal that anesthetizes all of the cutaneous nerves. Should one find difficulty in introducing the needles A and B and guiding them around the arm, the same results may be obtained in anesthetizing the cutaneous nerves as shown in Fig. 12 with needles A and A' the points of which raise a subdermal wheal through which needles B and B' are inserted to complete the circular subcutaneous wheal. At the inner border of the biceps needle C is introduced and directed toward the posterior surface of the humerus, projecting the solution as the needle advances. When it has been inserted into the tissues 1.5 cm., 5 c.c. of solution are injected. It is then inserted in the same axis another centimeter and 5 to 10 c.c. of solution are injected. This anesthetizes the cutaneous, antibrachial and the ulnar nerves. The needle point is withdrawn to the skin surface and inserted toward the anterior surface of the humerus, and as it advances 10 to 15 c.c. of solution are injected into the tissues, to anesthetize the median and musculocutaneous nerves. The needle is then withdrawn and inserted through the skin at the outer border of the biceps directly towards the center of the humerus, until its progress is stopped by the bone. Inject 10 c.c. of solution. Withdraw the needle E to the skin surface and reintroduce it to the posterior part of the humerus; again inject 10 c.c. of the novocaine solution. This anesthetizes the dorsal cutaneous, antibrachial and the radial nerves. This technic suffices only for anesthetizing the radial nerve at the level illustrated, because at a higher level the radial nerve is internal to the humerus, as are the ulnar and median nerves. At a lower level it is external and anterior to the bone.

Ten minutes should elapse before manipulations are attempted, at which time anesthesia should be complete. When a needle is being inserted only very small amounts of the novocaine solution should be injected at a time. As the nerves are

approached by the point of the needle the piston of the syringe should be withdrawn, and if blood does not appear in the barrel of the syringe the injection is made. If blood is observed in the syringe it indicates that the needle tip is within a vessel and it should be slightly withdrawn or inserted deeper before the injection is made. To avoid injecting the solution into a vein after blood is observed in the barrel of the syringe it is advisable to disconnect the syringe from the needle and expel the contents to remove the blood-stained solution. When a blood vessel is penetrated with a small gauge needle little or no harm is done. The edema produced by the subcutaneous wheal disappears by the time anesthesia is complete. One need not hesitate to apply splints or a plaster cast as the case may indicate.

To reduce fractures of the ulna and radius it is advisable to inject the anesthetic solution a couple of inches above the fracture, but should the operator feel that he is not absolutely certain of his nerve relations the injections may be made as shown in Figure 11 by raising a circular subcutaneous wheal about the arm, at the site of the fracture, with needles A and B and injecting 10 to 15 c.c. of a novocaine solution through each of the needles C, D and E, and between the fragments of the bones to anesthetize the radial, medial, ulna and interosseous nerves as shown in Figure 11, inset. This procedure simulates local anesthesia in that the anesthetic solution is injected directly into the field to be anesthetized. Due to the contour of the forearm it is advisable to raise the primary wheal laterally instead of over the anterior surface as in the upper arm. The subcutaneous wheal is produced by using a 4 inch needle, which is guided through the tissues by the finger tips of the left hand (inset, Fig. 11).

Should the operator feel that he is not absolutely certain of his nerve relations the injections may be made as shown in Figure 11, by raising a circular subcutaneous wheal

with needles A and B, and injecting 10 to 15 c.c. of solution through each of the needles C, D and E, to anesthetize the radial, medial, ulnar and interosseus nerves (inset, Fig. 11).

Until one has become well acquainted with the technic often twice as much solution will be required to produce satisfactory anesthesia, that is instead of using 50 c.c. to anesthetize the forearm, possibly 100 c.c. will be required by one unfamiliar with the technic. One should not hesitate to use a quantity sufficient to produce satisfactory anesthesia.

For a fracture of the lower third of the tibia and fibula a primary intradermal and subcutaneous wheal is made as described in the arm cases. Needle C is introduced external to the tibia and carried backward and outward in such a manner that it will pass over the outer border of the fibula. About 20 to 25 c.c. of novocaine solution are deposited as the needle advances. This will suffice to anesthetize the deep and superficial peroneal nerves. There is little or no danger of penetrating blood vessels in this field. The needle is withdrawn and reinserted through the mid-portion of the soleus muscle. When it has penetrated the tissues 1.5 cm., 10 c.c. of novocaine solution is injected. The needle is then advanced until its progress is stopped by the posterior border of the tibia. When it is withdrawn 1 cm., 10 c.c. of the anesthetic solution is again injected to anesthetize the posterior tibial and medial cutaneous nerves.

To anesthetize the penis for circumcision, ureterotomy, fistula, anterior strictures, plastic operations or amputation, a wheal is raised on the base of the penis below the pubic spine. A  $2\frac{1}{2}$  inch needle is bent in a semicircle, similar to a half-curved surgeon's needle. The penis is held in position with the left hand. The needle attached to the syringe is introduced through the wheal and carried down to the corpora cavernosa on the right side. Three to 4 c.c. of novocaine solution are injected (Fig. 13). The needle is then guided around

the penis, projecting 1 c.c. of solution for each centimeter of tissue traversed to the raphe. The needle point is withdrawn to the skin surface. The skin including the wheal is displaced slightly to the left. The needle is reintroduced as before and a subcutaneous wheal made on the left side to the raphe, to meet the wheal produced on the right side. These injections block the dorsal nerves of the penis and their branches (Fig. 13 A). For a simple circumcision satisfactory anesthesia may be secured by raising a wheal on the dorsum of the penis midway between the symphysis and glans, and through this the curved needle is introduced to the right. Five to 6 c.c. of solution are used to produce a subcutaneous wheal on the right side. The needle point is withdrawn to the skin surface and a wheal is produced on the left side in a similar manner (Fig. 13 B).

All operative procedures upon the hands may be performed painlessly by anesthetizing the cutaneous, ulnar, median and radial nerves at the wrist (Fig. 11). If an infection or cellulitis of the hand exists it is preferable to produce the anesthesia well above the infected region in order not to contaminate the healthy tissues. For severed tendons the anesthesia should be produced high enough to enable the operator to dissect out the retracted tendon. When the parts are not infected it is advisable to anesthetize only that part of the hand or fingers upon which the surgical procedure is to be carried out. The fingers may be anesthetized above the metacarpophalangeal articulation. If, for instance, the index finger is to be anesthetized a wheal is raised on a dorsal surface of the hand above the metacarpal articulation. The patient's hand is held by the operator's in such a manner that the surgeon's fingers are in the patient's palm. The thumb of the left hand glides the skin containing the wheal toward the thumb. A 2 inch needle is inserted through the inner border of the wheal, and so adjusted that the bevel faces the

metacarpal bone. It is then passed along the side of the bone slowly injecting the solution as the needle advances. When the point of the needle is felt by the operator's fingers on the palmar surface a subcutaneous wheal is raised with 2 or 3 c.c. of solution. The needle is then withdrawn again slowly injecting the novocaine solution. The patient's skin is pushed outward and the needle is rotated so that the bevel faces the outside of the metacarpal bone. It is again introduced until the tip is felt by the fingers in the palm, injecting 3 or 4 c.c. of solution as the needle proceeds (Fig. 14). Four to 6 c.c. of a 1 per cent novocaine solution should be injected on each side of the metacarpal bone. The needle should never be permitted to penetrate the palmar surface of the hand. If two or more fingers are to be anesthetized a subcutaneous wheal is raised on the back of the hand, and subsequent injections made through this wheal as shown in Figure 15. Five to 7 c.c. of a 1 per cent novocaine solution should be introduced into each interosseous space. After the injection is made the hand should be gently massaged to disseminate the novocaine solution. Anesthesia should extend to the finger tip in five to six minutes. It is inadvisable to attempt any operative procedure until the tip of the finger is completely anesthetized. Twenty-five to 35 c.c. of a 1 per cent novocaine suprarenin solution should be sufficient to anesthetize all of the fingers.

To anesthetize an individual finger a wheal is raised over the base of the first phalanx. The patient's finger is held by the operator as shown in Figure 16. The skin and wheal over the base of the finger are pushed outward by the thumb 2 to 3 c.c. of solution are slowly injected as the needle advances until the tip is felt by the fingers of the operator. The needle is withdrawn, the skin and wheal are retracted inward by the thumb of the operator, and 2 to 3 c.c. of solution are injected in a similar manner on the inner side of the phalanx (Fig. 17). Care should

be taken not to inject too much solution as this may produce a constriction about the finger and impair circulation. If the tissues are too much edematized or if too great a constriction is produced, necrosis of the tissues may be produced. When injections are made around or about a bone the bevel of the needle should be in apposition to the bone. If the point of the needle is directed toward the bone it may penetrate the periosteum or catch in the bone, bend or break the point, or possibly break the needle.

Anesthesia of the feet or toes may be produced with a very similar technic to that of the hands. If an operation for hallux valgus has once been performed with conduction anesthesia I doubt very much if the operator would ever use any other method. The patient is conscious, the motor function is not disturbed and when the operation is completed the operator is enabled to observe the function of the joint.

Raise an interdermal wheal  $1\frac{1}{2}$  inch above the metatarsophalangeal articulation. Attach a  $2\frac{1}{2}$  inch needle to the syringe. The operator places his fingers under the sole of the foot and the thumb displaces the wheal outward over the first interosseous space. The needle is introduced through the wheal. Five to 7 c.c.s of a 1 per cent novocaine solution are injected as the needle advances to the plantar surface. The needle is withdrawn, the thumb of the operator retracts the wheal to the inner surface of the metatarsal bone. The needle is then inserted to the inner side of the metatarsal bone (Fig. 18) and an equal amount of solution injected. As soon as the solution penetrates the skin it anesthetizes the dorsal cutaneous nerves; the peroneus nerves are encountered opposite the dorsal surface of the metatarsal bone, (Fig. 19); the needles approximate the medial and plantar nerves on the sole of the foot as shown in Fig. 18, inset. If the entire foot is to be anesthetized the technic is similar to that of anesthetizing the hand. The needles are inserted



through the interosseous spaces as shown in Figure 19. The technic for anesthetizing a single toe is as simple as anesthetizing a finger. The great toe, due to its size, necessitates the raising of two wheals internal and external to the tendon (extensor hallucis longus). Two to 3 c.c. of a 1 per cent novocaine solution are injected on each side of the phalanx (Fig. 20).

The other toes may be anesthetized from a single wheal raised on the dorsal surface; 1.5 to 2 c.c. of solution on either side of the bone will be sufficient to produce complete anesthesia.

It is hoped that these suggestions will be of some assistance, in minor surgery, to the isolated practitioner, industrial surgeon and those members of the profession who are not familiar with novocaine anesthesia.

Picture a patient fighting, gagging, coughing, suffocating and cyanotic from inhalation narcosis, as compared to the

patient who is comfortable, at ease, laughing and talking with his doctor doing the operation.

Try and visualize the patient's discomfort for the first twenty-four hours following general anesthesia, as compared with the one that has had all of his fingers amputated with conduction or local anesthesia, who is permitted to go home and eat a hearty meal.

Should a patient be subjected to the possibilities of anesthesia nausea, vomiting, distention, bronchitis, pneumonia, lung abscesses and innumerable other narcosis complications, when they may be avoided? Would you submit to ether anesthesia to have an ingrowing toe nail removed? No. Then why compel a patient to take it.

Why have thousands of physicians adopted local conduction and spinal anesthesia in the last few years in preference to inhalation narcosis? Because it is safer.



## THE USE & ABUSE OF ANTISEPTICS\*

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THERE is still great variation of opinion as to the value of antiseptics.

The most blind faith appears amongst those chemical manufacturers who send round advertisements showing how easily microbes can be killed by the particular antiseptic they are recommending. The extreme form of scepticism is found among certain laboratory workers who contend that it is the physiological response of the body tissues, and not the antiseptic, which kills the microbe. Between these extremes come the clinicians who vary from the conscientious believer in the efficacy of antiseptics, to the perfunctory user who has little faith in their value. Very few have a discriminating judgment in the matter. This is not to be wondered at since clinical and laboratory evidence often

appear to contradict one another, and principles have been neglected for rule-of-thumb practice. Before trying to estimate the true value of antiseptics, one must cast aside some of the commonly employed untrustworthy criteria. Little reliability can be placed on experiments showing the power of an antiseptic acting in a watery medium, for in the body it has to act in a serous fluid. Nor can one make a true judgment of its effect on microbes in the wound without at the same time allowing for the extent of its deleterious action on the body tissues, the speed with which it acts, and the type of wound to which it is applied.

The contrast between the aseptic and the antiseptic schools is a false one, and the founder of antiseptic surgery fully

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appreciated the value of both methods. Lister's aim was to produce an aseptic wound by antiseptics, but he quite realized that where infection was minimal, aseptic technic could produce as good results as the antiseptic method. He wrote "These two great truths have been taught us by advancing science, that normal serum is not a good soil for the development of attenuated microbes and that bacteria introduced among the tissues, if in not too concentrated form, are disposed of by phagocytosis." Those who stress the damage done by antiseptics to the tissues are only following the lead of Lister who wrote: "In treating surgical cases antiseptically I always endeavour to avoid the direct action of the antiseptic substance upon the tissues, so far as was consistent in the existing state of knowledge with attaining the essential object of preventing the development of injurious microbes in the parts concerned."

It will serve to clarify our ideas if we consider the subject with reference to the different varieties of wounds which for our purpose may be classed as:

1. Clean.
2. Contaminated.
3. Deeply infected (including nearly all gunshot wounds).
4. Granulating.

A few words may finally be devoted to the action of antiseptics on microbes dwelling on intact surfaces.

1. The clean wound is one made under aseptic conditions by the surgeon, or made accidentally with so little chance of contamination that for practical purposes it may be deemed sterile. Such wounds do not need the application of any antiseptic, though every effort must be made to maintain the aseptic state by seeing that everything which comes in contact with the wound is sterile. Gloves, dressings and suture materials must be sterile.

2. The contaminated wound is one in which pathogenic organisms have been planted on the surface, but have not had

time to grow out into the tissues. Can antiseptics destroy the bacteria in such a wound? If so, for how long after the contamination is such a destruction possible?

Experimental work on this problem is apparently contradictory. On the one hand Fleming<sup>1</sup> made glass tubes with special recesses, and found that microbes planted in the recesses were not killed by antiseptics placed in the tube. On the other hand Carl Browning<sup>2</sup> and his co-workers experimenting on guinea-pigs found that acriflavine solution applied to a subcutaneous pocket planted with virulent bacilli, always killed the organisms, provided the strength of the solution was as much as 1:1000, and the application was made within two hours of the bacterial implantation. These experiments were controlled. The final judgment in this matter should rest with the clinician, but there are suprisingly few scientifically accurate clinical observations recorded. Fortunately it was in the recently contaminated wound that Lister first demonstrated the value of antiseptics. In his first communication on the subject, Lister recorded 11 cases of compound fracture. In 2 he does not mention how long after the infliction of the wound the application of the antiseptic was made, but in the other 9 cases full details are given. Suppuration occurred only in 2 cases in which the antiseptic was applied respectively four and six hours after the accident. No suppuration occurred in the other cases which were more promptly treated, nor did infection gain a hold in one small wound treated six hours after the injury. We think the results of general clinical work bear out the view supported by Lister's original record and Browning's later experiments, that contaminated wounds treated adequately by antiseptics, within four hours of infliction, do not suppurate. This means that the casualty department should be run on antiseptic lines. We have not space here to discuss the best antiseptic to apply, nor the best

<sup>1</sup> FLEMING, A. *Brit. J. Surg.*, 7: 99, 1919-1920.

<sup>2</sup> BROWNING. *Brit. M. J.*, 1: 73; 2: 70, 1917.

method of application, but it is important to insist that the dressing to the wound should be large enough and impregnated with sufficient antiseptic to prevent microbes gaining access through the dressing.

3. The next class of wound is the deeply infected wound, i.e. one in which the organisms are no longer confined to the most superficial layer of the wound, but have begun to grow out into the tissues. Generally speaking, if a contaminated wound is untreated it must be regarded as deeply infected after four to eight hours. Of course it will be quite clear that a good deal depends upon the amount and virulence of the initial contamination. Nearly all gunshot wounds must be regarded as deeply infected from the first, since the force of the missile drives any organisms deeply into the tissues. This lesson was only tardily learned in the Great War.

Can antiseptics help in this group? Theoretically the answer must be very doubtful, for antiseptics which are strong enough to kill microbes would also seriously damage the tissues into which they had penetrated. But there are other factors to be considered, for it has been shown that antiseptics cause a flow of serum which is antibacterial to most organisms, though not to the dreaded streptococcus. Fleming found that in the concentrations commonly used for the treatment of wounds, most antiseptics will inhibit the growth of organisms in serum, and even in some cases kill organisms in pus, yet they at the same time retard the emigration of leucocytes, and diminish their phagocytic power. The ultimate effect of an antiseptic is therefore a complex problem. Experimenting with a chronic septic wound, Fleming found that neither the instillation of, or irrigation with an antiseptic had any great influence in diminishing the number of microbes in a wound. We accept Fleming's work as conclusive as regards most of the common antiseptics, and clinical work largely bears out his

conclusions. We all know that septic wounds which are washed out with an antiseptic solution still continue to discharge pus, and any rapid improvement is as likely to be due to the natural resistance of the tissues as to the antiseptic. From this general condemnation, however, we would except the flavine and the hypochlorite groups of antiseptics. Those in the flavine group act very strongly in serum, and Fleming's experiments with them were not so convincing; while the hypochlorites have a very rapid action, cause a considerable flow of serum, and are backed by strong clinical support. In the case of most antiseptics we conclude that their chief benefit, when used to wash out, or apply to a deeply infected wound, is to ensure the sterility of the fluid used and to prevent the introduction of further organisms.

The ordinary antiseptics were proved to be of little value in dealing with gunshot wounds in the early days of the Great War, and it was because of this failure that Sir Almroth Wright sought to encourage the physiological response of the body by applying hypertonic salt solution to wounds. There is no doubt that the application of this solution causes the flow of an albuminous fluid with considerable antibacterial properties, but the leucocytes are repelled by the hypertonic solution. If this method of treatment is adopted normal saline must be applied alternatively with the hypertonic solution, so that leucocytes may be permitted to come into the wound.

The infected track of the majority of gunshot wounds is inaccessible to ordinary antiseptic applications, so that excision of the track is the method of choice when possible. After excision the wound can be treated by the physiological or antiseptic methods, preferably by the antiseptic Carrel-Dakin technic. The stuffing of antiseptic powders or pastes or even salt packs into the narrow track of a gunshot wound has nothing to commend it.

4. In a granulating wound the healthy tissues next the injured part have formed a natural barrier against infection and the rational plan for the surgeon is to do everything he can to protect those delicate granulations. They may be injured by accumulated discharges therefore drainage must be efficient; they may be irritated by foreign bodies which must be removed. They may also be seriously damaged by antiseptics and this fact should prevent the surgeon ever applying strong antiseptics to a granulating wound unless he wishes to destroy exuberant or feeble granulations.

It has been satisfactorily proved that most antiseptics have little or no effect in reducing the number of organisms on the surface of a granulating wound, so that the common routine washing out of healing wounds can have little action but the removal of debris to commend it. The only exception is that of the hypochlorites. Experiments by Parry Morgan on films of pus in vitro and investigations by Fleming on a granulating wound in vivo, show that the hypochlorous solutions are likely to have a definite bactericidal effect on the organisms on the surface of a granulating wound even if used merely as a lotion to wash the surface.

There is no need to wash out the cavity of an ordinary abscess. In relating the treatment of an acute abscess by incision and drainage Lister made the significant remark: "The antiseptic substance was never from first to last applied to the cavity of the abscess as such treatment could only have been productive of needless irritation."

We can summarize our conclusions by saying that all the evidence goes to prove that antiseptics are not needed in clean wounds, but are exceedingly valuable in recently contaminated wounds; while in deeply infected and granulating wounds they have little direct antibacterial action except in the case of the hypochlorites. The success of the Carrel-Dakin technic

bears out clinically what the laboratory asserts.

#### EFFECT OF ANTISEPTICS ON SKIN AND MUCOUS MEMBRANES

Experimental work shows that it is exceedingly difficult to kill the organisms in the depths of the skin. It is indeed doubtful whether it is possible to sterilize skin without doing too much damage to the normal cells of the part.

This fact should enforce the wearing of sterile gloves for operations. Nevertheless though one may not be able to render the deep parts of the skin absolutely sterile there is good clinical ground for believing that some antiseptic applications are valuable for rendering the surface almost sterile. The use of tincture of iodine, picric acid solution, and some of the aniline dyes has strong clinical support, and the experiments of Lister showing that carbolic acid had a special avidity for hair makes a 1:20 or 1:40 solution suitable for application to the scalp (away from the eyes) the axilla and peri-anal tissues.

Mucous membranes are more delicate than skin and we are not aware of any reliable controlled clinical or experimental work which supports the view that microbes lodged in crypts or recesses can be killed by antiseptics. It may well be that organism which have just been planted on the mucous membrane may be killed by an antiseptic application. This would be parallel to the treatment of a recently contaminated wound and supports the practice of applying a solution of silver nitrate to a conjunctival sac recently infected with the gonococcus. But the washing out of infected mucous cavities with antiseptic solutions has little to support it other than that the antiseptic keeps the fluid sterile.

Unless the principles underlying treatment by antiseptics are understood success can only be accidental. It should be the aim of every practitioner to understand principles so as to ensure success.

# DISLOCATIONS OF THE SHOULDER\*

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## FREQUENCY

ABOUT half of all dislocations are of the shoulder, roughly 4 in males to 1 in females, occurring at any age but with increasing relative frequency as age advances.

## ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS

The fundamental reason for the greater frequency of dislocations of the shoulder joint is that here nature has found mobility more useful than stability.

This great mobility is permitted by the peculiar construction and roominess of the capsule and by the small size of the glenoid cup covering as it does, even when expanded by the cotyloid ligament (labrum glenoidale), only about one-third of the cartilaginous surface of the head of the humerus.

An essay might be written on the question "What keeps the head of the humerus in place?" and this most interesting phenomenon not be adequately explained. Suffice it here to say that the matter is most complex, many forces and many organs taking part in it.

All the muscles connecting the humerus with the scapula, even the greater pectoral, by their tone assist and by active contraction in a sort of reciprocal relation: when one group contracts, its antagonists relax. Of these the most effective in this relation are the deltoid, and supraspinatus and the triceps; witness the ease with which dislocation occurs in poliomyelitic paralysis of these muscles.

The capsule is wonderfully built to permit such free motion as that of the shoulder joint and yet make important, perhaps the largest, contribution to its stability.

Atmospheric pressure is given the major

place by some, but atmospheric pressure can become effective only in case a vacuum is formed in the joint. If such were present it would soon be filled with serum and blood and the pressure would cease, but if any force pulls the head of the humerus away from the glenoid such a vacuum is instantly formed. In other words atmospheric pressure is ready to resist any such motion though it does not maintain pressure otherwise. Atmospheric pressure does not prevent the weight of the arm producing a subluxation in deltoid paralysis.

Much the same can be said of capillarity though it may well be that this force deserves the major position; witness the adhesion of "optically" perfect surfaces anywhere; the lung to the chest wall (Macewen), the lids to the eyeballs, the boy's famous "sucker" to the cobblestone.

## CLASSIFICATION

Most classifications of shoulder dislocations are based on the positions in which the head of the humerus comes to rest, secondary positions, but a clear understanding of the etiology and therapy requires knowledge of the primary positions i.e., the positions of the head of the humerus as it leaves the socket and thence the location of the rent in the capsule and other damage done.

Well over 90 per cent of all dislocations of the shoulder are primary subglenoid displacements in front of the triceps tendon.

Primary posterior dislocation is next in frequency but is not common, in fact comprising not over 2 per cent of all dislocations of the shoulder. The head of the humerus may go out between the tendon of the triceps and the teres minor but may be above the latter, coming to rest under the acromion or under the spine of the scapula, generally complicated

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by tearing off of the subscapular muscle or the lesser tuberosity.

The secondary or final positions of the head of the humerus are many. The principal anterior dislocations are, in order of frequency: subcoracoid, subglenoid and subclavicular and the rare *luxatio erecta*. Posterior dislocations are described as subacromial and subspinous with the rare, even disputed subtricipital dislocation, the result of internal rotation of the shaft with pressure backward, comparable to the reversed anterior dislocation of the hip.

#### MECHANISM

In the laboratory the humerus may be readily dislocated by a heavy blow struck in a downward direction on the upper part of the abducted arm and posterior dislocation may be produced by forced internal rotation with something of a blow in front. There is no doubt that dislocations as seen clinically are sometimes produced by such blows on the top of the shoulder, as in falls forward or backward, but the great majority occur as the result of leverage, often doubtless with some thrust added.

Abduction of the shoulder is normally limited by tension of the lower portion of the capsule, balanced by compression of contact of the head of the humerus with the glenoid. If abduction be forced beyond the limit something must give way; the surgical neck of the humerus, the neck of the scapula, the greater tuberosity which impinges on the upper border of the glenoid or the capsule of the joint.

The capsule may yield in its continuity or it may be avulsed at its insertion at the edge of the glenoid or at the neck of the humerus. Most commonly it is torn in continuity in its lower portion, perhaps because the curvature of the head of the humerus is greater there than elsewhere. The greater tuberosity comes into contact with the upper edge of the glenoid, to which point, therefore, is instantly trans-

ferred the fulcrum or center of rotation which is normally at the center of the head. The short arm of the lever is thereby lengthened so that further abduction forces the head of the humerus out of the rent in the lower limb of the capsule and lifts its surface away from that of the glenoid. The protrusion is made still greater by the fulcrum being transferred to the acromion or the coraco-acromial ligament, for in further elevation of the arm or further abduction the surgical neck of the humerus comes into contact with the one or the other. Even slight thrust will now serve to throw the head of the humerus completely off the glenoid into the axilla.

This mechanism is that of an exceedingly common accident; people fall forward or sidewise, throw out their arms for protection, the arm, inadequate to overcome the momentum of the body, is forced into exaggerated elevation or abduction. In the former the acromion or coracohumeral ligament becomes the fulcrum, in the latter the greater tuberosity at the edge of the glenoid. But since hyper-elevation in the sagittal plane ordinarily occurs with the arm in internal rotation, the greater tuberosity is thrown against the edge of the glenoid even in this motion.

When the arm is brought down to the side the head takes its so-called secondary position. Since the majority of falls producing dislocation are forward, the arm is forced backwards, the head is thrown forward and inward, the degree of mesial displacement depending on the force of the longitudinal thrust.

Thrust with the arm in full extension is the cause of the interesting though rare "*luxatio erecta*," in which the arm is held straight up above the head. In a personal case the patient tripped on a rug and fell forward catching her extended arm on a bureau.

It goes without saying that the greater the displacement the greater must have been the laceration of the capsule. In most dislocations the coracohumeral liga-

ment remain intact and like the ilio-femoral ligament determines much in the mechanism not only of production of the secondary positions of the head, but also of reduction. The same is true of the posterior portions of the capsule.

#### DIAGNOSIS

There should be no difficulty in making a diagnosis of any of the various forms of dislocation, but posterior dislocation was overlooked in the beginning in a considerable proportion of the cases reported and errors of diagnosis from fracture are too common. The loss of the roundness of the shoulder, Dugas' sign in anterior dislocation (inability to depress the elbow when the hand is on the opposite shoulder) positive palpation of the head of the humerus in its abnormal position, finally the x-ray which determines not only the fact of dislocation and the exact position of the head, but also shows complicating fracture if any be present. In dislocation the arm is generally held in elastic tension; in fracture of the surgical neck, mobility of the arm is unrestricted and the roundness of the shoulder persists. Moreover, the head fails to rotate normally with rotation of the shaft.

The careful surgeon will always assure himself, before instituting treatment, that the nerves and blood vessels are intact.

There is great advantage in having x-ray films taken in stereoscopic relation, for when viewed in a proper stereoscope many details can be observed which might otherwise be lost, such as the size and position of small fragments of bone.

#### TREATMENT

Most dislocations of the shoulder are easily reduced and without anesthetic, if taken while the tissues are still benumbed by the violence of the accident, but the difficulties of reduction increase with the passage of time until after a few weeks, they are so great as to make reduction all but impossible, even under anesthesia, and yet by using great force dislocations have been reduced even after several months.

Rarely dislocation is impossible of reduction from the beginning. Dollinger of Buda-Pesth operated on a considerable number and generally found the subscapularis muscle in the way. Cutting the muscle (and capsule) made reduction simple.

The head of the humerus may pass below and around or through the lower edge of the muscle and lie on its anterior surface, or by reason of thrust, it may pass through or above the muscle, reaching its anterior surface in that way.

The oldest method of reducing dislocation of the shoulder is by lateral traction with or without manipulation of the head. As a definite method it can be traced to Avicenna of the school of Salernum, but it is doubtless far older. It is not only the oldest method, it is really the best. It is efficient in most cases in which reduction can be effected at all, and is without danger. The method naturally has numerous modifications. One of the best is that of Stimson, in which the patient lies on his side on a cot set upon a table or chairs, his arm passed through a hole in the canvas of the cot, a weight tied to his hand. Such continuous traction soon tires the muscles and reduction is readily effected. Hofmeister does the same thing by having the patient lie on his sound side in bed or on the floor, traction being made by a cord attached to the hand of the dislocated arm and passed over a pulley on the ceiling, a gradually increased weight on the other end of the cord.

The essential element of all methods of reduction is to secure muscular relaxation. If one can pull the arm immediately after the accident and before muscular spasm has come on, reduction may be effected without the use of much force. Many a dislocation has been reduced by this means by sympathetic bystanders at the time of the accident.

While the use of great force in refractory cases was justified in pre-antiseptic days, it is so no longer. It is far preferable, less likely to do harm, to perform open opera-

tive reduction, provided, of course, that one has a reliable aseptic technic. In dislocations which are more than a few days old, adhesions have formed and these should be broken by rotation in various directions, and by abduction and adduction before attempt is made at reduction.

In our medical schools emphasis is put upon the Kocher method, in many no other is taught. The Kocher method, a development of the Schinzingler, is clever and most dramatic. Moreover, it is made attractive by the excellent illustration which has been copied everywhere, particularly the patient's expression of relief when reduction has been effected. It utilizes the untorn posterior parts of the capsule as fulcrum somewhat as the iliofemoral ligament is used in reducing dislocations of the hip. The method will undoubtedly reduce a large majority of anterior dislocations, but unless used with caution, is dangerous. I have known of several unpublished cases of intracapsular fracture of the head of the humerus, one of my own. It is difficult to realize the enormous rotatory force which one can exert on the cancellous upper end of the humerus by means of the forearm used as a lever. I believe that any dislocation which can be reduced by the Kocher method can be reduced by the method of lateral traction and with less risk.

Not less dramatic is the method of Sir Astley Cooper: traction downwards and outwards, countertraction being made with the operator's fist in the axilla or if more force be required, traction made by the operator with both hands and his unshod heel in the axilla. The traction is followed by adduction. If adduction is made before the head is disengaged from beneath the edge of the glenoid, fracture is likely to result, a longitudinal fracture running from the base of the greater tuberosity downwards, emerging on the mesial surface of the shaft. At least I have seen one such case.

#### OLD UNREDUCED DISLOCATIONS

In time mobility slowly increases, a

new joint forms, ligaments adjust themselves so even a dislocated arm may be useful. The cases should be studied individually and treatment undertaken according to the nature and degree of disability. Many would best be left alone, others, because of pain, loss of function, should be operated upon. Some can be reduced after cutting the contracted soft parts, but with others one can do little but resect the head of the humerus.

#### HABITUAL DISLOCATIONS

In habitual dislocation it is often a question whether the trouble is due to faulty union of the rent in the lower part of the capsule, or to retraction and loss of support of the supraspinatus muscle. T. Turner Thomas has had good results from suturing the capsule through an axillary incision, Perthes by shortening or re-attaching the supraspinatus. Habitual dislocation may give no trouble as long as the arm is not elevated beyond the horizontal. This may be prevented by apparatus, a strap connected with a belt may suffice, as in swimming.

There are, of course, other causes of habitual dislocation than repeated traumatic dislocation with wide tears in the capsule, such as poliomyelitic paralysis, fracture of the glenoid diminishing its already small area.

#### COMPLICATIONS

Muscle rupture is so common as to be almost a necessary part of the process of dislocation, especially of the subscapularis, the supraspinatus is not rarely torn off its insertion, the biceps tendon may be dislodged from its groove and become an obstacle to reduction, but it is seldom divided.

Nerve injuries, sometimes with more than temporary paralysis, are not rare, also damage to the axillary vessels. I have seen gangrene of the hand from obliteration of the axillary artery in a forward dislocation of the shoulder.

Fracture of the greater tuberosity is



commonly due to impingement on the edge of the glenoid but its points of attachment of the dorsal scapular muscles are often pulled away. Stereoscopic x-ray films are here invaluable.

Fractures of the upper end of the humerus as complications of dislocation vary greatly in form, from transverse fracture of the surgical neck to comminuted splintering of the bone. Probably they are not all caused by the same mechanism. The most common is the transverse fracture of the surgical neck, which may occur by leverage, the abducting or extending force continuing after dislocation has occurred; the head held by untorn parts of the capsule, the edge of the glenoid, the fulcrum (Stimson's suggestion) or the surgical neck of the humerus in contact with the acromion. Dislocation complicated by fracture of the neck of the humerus, has rarely been reduced by manipulation, but it is difficult, often impossible. Then it is best to cut down on the fracture,

drill a hole into the remnant of the shaft which remains on the head, passing a wire or a hook, and make traction. The head is thereby readily replaced. The wire may be used to fasten the head and shaft together.

#### AFTER-TREATMENT

It is common practice to bind the arm to the side for two or three weeks to favor healing of the wound in the capsule, motion being gradually increased after this date.

While complete fixation is not of great importance, fixation will at least prevent abduction in which position redislocation easily occurs. Prolonged fixation is apt to result in the formation of symptom producing adhesions, so that there are some advantages in early mobilization. Such mobilization should take the form of elevation of the arm in the sagittal plane as less likely to disturb the union of the capsule.



## SIMPLIFIED TECHNIC FOR INTRATRACHEAL INJECTION OF IODIZED OILS (LIPIODOL)\*

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THE generalized use of iodized oils for the diagnosis and treatment of diseases of the respiratory organs demands a technic that does not require a specialist nor complicated apparatus, and that is safe and painless to the patient.

The reason why intratracheal injections are difficult is that the instruments required are rather imposing looking and cause fear, discomfort and sometimes actual pain. The patient becomes scared and restless, consequently with certain procedures the danger of allowing some of the oil to drip in the esophagus is actually present.

The technic described here has been

used several hundred times, the cases including nervous women and children, without the slightest mishap.

The technic can be considered absolutely safe and easy. *In fact the dripping of oil in the esophagus is a practical impossibility.* The patient is not scared because only an instrument resembling the plainest tongue depressor is used. Not even a head mirror or the projection of light in the throat is required.

The only instruments used are the special cannula tongue depressor and a record syringe of suitable size (10 to 20 c.c.). (Fig. 1.) The cannula tongue depressor is a metal tongue depressor adapting

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itself to the tongue closely and along which runs a metal tubing. This metal tubing projects from both ends of the

which is attached a suitable tubing. It is advisable never to touch either the tongue or the palate directly but allow the

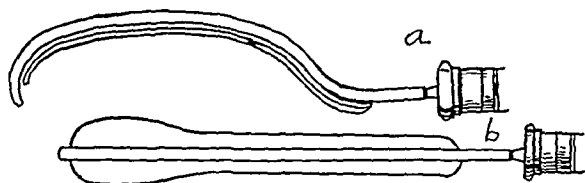


FIG. 1. Two views of cannula tongue depressor with tip of syringe attached.

tongue depressor: The end that comes in contact with the posterior aspect of the tongue is bent to such an angle and projects enough to engage itself into the epiglottis. The other end is adapted for insertion of the record syringe, containing the iodized oil. (Fig. 2.)

The procedure recommended is the following:

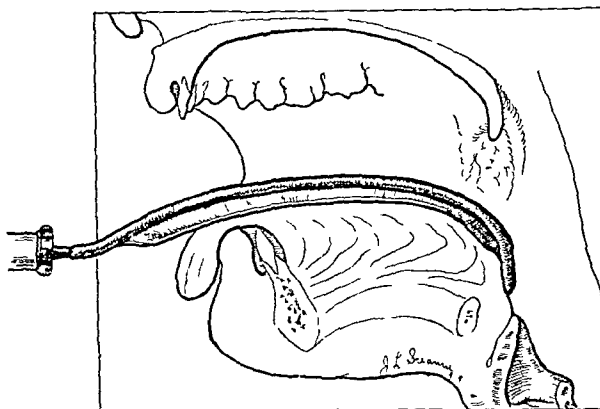


FIG. 2. Cannula tongue depressor shown adapting itself to whole tongue while tip of metal tubing becomes engaged in epiglottis.

solution to drop on the tongue. This because some patients gag and cough



FIG. 3. X-ray of patient fully dressed while iodized oil is poured into trachea. Note how it is impossible for iodized oil to drip into esophagus.

The patient sits erect and is told to open his mouth and push the tongue forward.

The throat is anesthetized by dropping slowly (drop by drop) on the back of the tongue 20 per cent watery solution of novocaine, either with pledgets of gauze held by any forceps or by a syringe to



FIG. 4. Iodized oil in bronchi.

very easily and persistently when the posterior aspect of the tongue or the palate is touched. In a few minutes the posterior aspect of the tongue, the epiglottis and the larynx are anesthetized. In order to make sure that the anesthesia is satisfactory, ask the patient if he feels that his throat is numb, if so apply the cannula

tongue depressor and if no reaction follows you can safely start the injection.

(The syringe has been previously filled with lukewarm iodized oil and inserted into the cannula.)

As seen by the illustrations the cannula tongue depressor adapts itself closely to the tongue. The curved tip is engaged in the epiglottis. (Figs. 2 and 3.) All that is needed is to gently press the cannula tongue depressor on the tongue while gently pulling it forwards. Thus you are sure that in pulling the tongue forwards the tip of the cannula tongue depressor is and remains engaged in the epiglottis. Consequently with the organs properly anesthetized it is a *physical impossibility to cause dripping of oil into the esophagus even if the patient moves the head.* (Figs. 2 and 3.)

The injection will be more successfully and easily accomplished the less the patient has been frightened. You tell the nervous patient that you only want to apply the tongue depressor on the tongue. (You do not even need to look into the mouth); the actual injection then requires so little time that the patient will be most agreeably surprised to know that the whole procedure is over before he thought it had been started.

By the method described injection of iodized oil has become such an easy procedure that we do not even require our patient to undress or open their collars, when the latter are not too tight.

If it is desired to inject only one lung, all that is necessary is to have the patient lean slightly on the side which should be injected.



## BURNS\*

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**B**URNS are unexpected accidents and their sudden occurrence finds the victim and his comrades unprepared to meet the emergency. The first aid that is given is very important in the later treatment. The agents causing the tissue reaction or destruction are many: dry heat, moist heat, chemicals, mechanical friction, x-ray, actinic rays and electricity.

In each case there is a destruction of tissue, or a tissue reaction, and its influence on the human body will be directly proportional to the amount of toxin absorbed. The amount of toxin absorbed will depend on the area of the body involved. It is an old clinical observation that if one-third of the body area is involved, the prognosis is grave and often fatal. Children do not tolerate burns so well as adults; and with them, burns of the face, neck and head, as well as burns of

the large serous cavities, are more serious. The damages caused by burns, whatever the degree, are destruction of tissue, the formation of toxins, and the presence of secondary infection with the development of other toxins. These toxins are quickly absorbed, and the body has to take care of them. The circulation carries these toxins to the liver and kidneys, and they are eliminated through the kidneys. The kidneys show impairment by a reduction in the amount of urine and the presence of albumin, casts, and red blood cells in the urine.

The problem that presents itself in the treatment of burns then is the following: first, the prophylaxis; second, the emergency treatment; third, the treatment of toxemia; and fourth, the treatment for replacing the lost tissue.

The prophylactic treatment is lay educa-

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tion for the innocents and the educated: first, that fire will burn; and second, what will make fire. This has been carried on, but still there are people who will light a match to see if their gasoline tank is full.

The best emergency treatment is to summon medical aid, or take the patient to a hospital where proper aid can be given. The use of water on burns with different ingredients to relieve the pain and burning is a poor procedure, because this may wash off some of the toxins; also it will bring in more infection and, by moistening the destroyed tissue, aid in the absorption of the toxins. For the relief of pain, the clothing which causes pressure or dragging on the damaged area should be removed and then a 2.5 per cent solution of tannic acid should be applied by means of a spray every fifteen minutes until the destroyed tissue assumes a tan brown color and a coagulation takes place. Covering the burnt area will ease the pain, shut out infection and catch all the toxins in the coagulum and prevent their entrance into the body. During this procedure the body should be kept warm and symptoms of shock combated by means of warm drinks, such as coffee or tea, and the injured person kept flat on his back or side, depending upon where the burn is. In addition, morphine in sufficient doses should be used to relieve the pain.

Shock and toxemia have to be combated. Even if the coagulum takes care of most of the toxic products, there will be some absorbed, and shock in varying degrees will be present. The recumbent position, or lowering the head of the patient, the maintenance of the external body heat, and the administration of fluids will combat shock and aid the body in eliminating the toxins. What fluids are the best? It is our practice to give our first fluids intravenously in order to give the patient immediate benefit. This is done where there is a moderate degree of shock. Six hundred cubic centimeters of a 5 per cent glucose solution are given. This seems to increase the blood volume,

dilutes the toxins, and brings 120 calories of available energy to the body. Normal saline solution is given as proctoclysis. The degree of shock and its persistence or improvement is determined by means of blood pressure readings every fifteen minutes, watching the pulse rate, and the general condition of the patient until there is an improvement warranting a greater interval. The effect of toxins on the body is watched through the urine. The total twenty-four hour output, and its complete examination, compared with the twenty-four hour intake will give fairly accurate evidence as to the degree of absorption and the influence on the kidneys. By the use of this method, where there ordinarily is scanty, high specific gravity urine with the presence of albumin, casts, and red blood cells, we find an almost normal urine. This method combats the absorption of toxins through their being caught in the coagulum. Infection which may enter is at a minimum, since absorption is prevented when the toxins are shut off from the capillary system. Shock and what little absorption might take place are treated with glucose and saline solutions. The vicious circle present in the older forms of treatment is broken by almost completely eliminating the toxic products that follow thermal destruction of body tissue. The reason for not using any oily solutions in the emergency treatment is self evident. If an oily solution is used first, the aqueous solution of tannic acid will not be able to permeate the destroyed tissue so completely, and more absorption will take place.

The repair of tissue defects and restoration of function are very important. The restoration of function should always be in mind from the very beginning. Limbs should be placed in the proper positions, but that alone is not sufficient. As healing takes place, the limbs that were in proper positions are soon drawn into improper positions. Hence constant care must be exercised. The closure of defects may be greatly aided by timely grafts of skin,

either Thiersch, Reverdin, or whole thickness of skin. The sooner this is done, the better the result will be. As soon as the coagulum is ready to fall off, there is a bed of granulation tissue. This will immediately become more heavily infected if not protected. Our practice has been to use hot boric and alcohol dressings, changing them every four hours until the granulation has developed a healthy red color. The night before the graft is to take place, the whole area is painted with one-half strength iodine solution and a dry dressing put on. This dressing is removed the next day,

and Thiersch grafts are laid on. These grafts are covered with a wire cage, and sterile gauze is placed over the cage. It is not changed for twelve days. Then the crusts of serum are removed and the field is almost entirely covered with new skin. After this just a dry dressing is used; or, if this sticks, a boric ointment dressing is used instead. To obtain a complete return of function where it is impaired will necessitate careful medical care. Massage, exercises, and plastic operations should all be used at appropriate times and when indicated.



## PESSARIES IN GYNECOLOGY\*

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THE art and practice of medicine is in continual flux—new ideas and methods supplant the old, as it should be, but occasionally a good method is lost sight of in the seeking of the new, and this we find to be true in the use of the pessary. It has been described as a "lost art," and one has only to scan the various medical indices to be appraised of this fact, for today there is hardly an article written on the use of the pessary, while twenty years ago, thousands of printed pages sought one's attention.

The decline in the use of the pessary can be traced in large measure to the wide field that a more perfect operative technic has opened, to a consequent limiting of the indications for the use of the pessary, to a more proper interpretation of pelvic pathology and to a crowded curriculum in the medical school, this teaching often being of a more scientific nature, replacing in turn methods that perhaps are at times empirical and unscientific, and yet of inestimable value to the specialist and general practitioner.

In the days gone by many a heated

argument was heard as to whether a pessary is a lever, a crutch or what-not. In order that we may not transgress to useless polemics, let us state that it may be at times any of the things that its old protagonists proclaimed, but above all, it is a support, and if we consider it as such, the indications of its use and the contraindications thereof can be the more easily evaluated.

The pessary has also been the cause of verbal wars, not only as to the material it should be made of (wool, hair, thread, silver, gold, platinum, horn, bone, wood, celluloid, hollow tin, German silver, glass and rubber in all its varieties, and still the list is not exhausted), but also the shape it should assume, so that in a catalogue of years gone by there were pessaries of every shape and size made of many different materials and all bearing a separate and infallible promise, the name of the man who devised that particular shape or added that particular curve, so that the poor doctor, with his many and varied duties, instead of becoming a pessalogist, became a pessimist, and

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perhaps another reason added why the pessary has lost caste. At the start let us say that we shall not give you a long

dissipated; that the intellectual and spiritual being may be elevated from the lowest states of depression, bordering on melancholy,

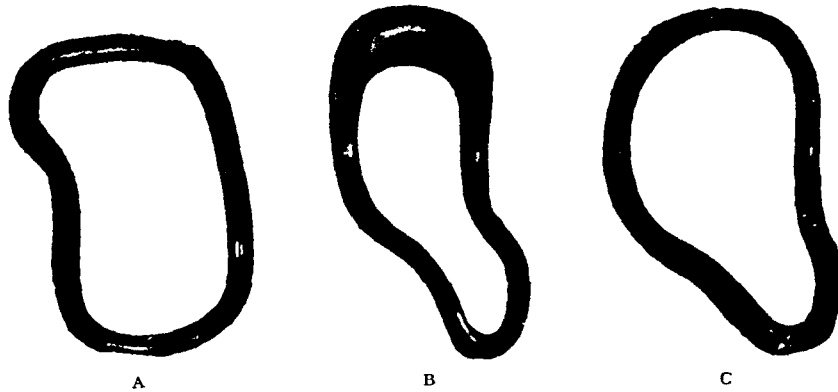


FIG. 1. A. Hodge pessary. B. Albert Smith pessary. C. Thomas pessary. (From Crossen's "Diseases of Women," C. V. Mosby & Co.)

galaxy of names, famed for their pessaries, but rather to point out that each and every pessary must bear the imprint of the doctor using the same.

What then can we say in defense of a practice that has in many ways been relegated to the ground of "has been?" Only this, that a pessary when properly applied in the proper case is a most valuable aid, not only to the patient but to the doctor, relieving pain and discomfort, and at times enhancing a more normal physiology, resulting in turn in a cure of the condition complained of; and, furthermore, it is a most servicable aid for those cases on whom an operation is not advisable, whether it be for age or constitutional illness, etc.

It might prove of interest if we quoted the opinion of one of the masters in the not too antiquated past. I quote from "Diseases Peculiar To Women" by Dr. H. L. Hodge, 1860:

The long experience of the author in the use of pessaries will perhaps justify the expression of his opinion . . . that the local symptoms of weight, pain, etc., the leucorrhea, the menorrhagia and the dysmenorrhea, and all the innumerable direct and indirect symptoms of spinal and cerebral irritation, including neuralgia, nervous headache, nervous affections of the larynx, lungs, heart, stomach, bowels, etc., as also spasms, cramps and convulsions, may often thus be

or be delivered from the highest degree of maniacal excitement; and that the whole economy may thus be revolutionized.

Quoting further on the reflex influence of the pessary at the time of introduction: "'Oh, Doctor!' exclaimed a cheerful and intelligent lady, 'you hurt my neck, my shoulder, my side, my knee,' and all this in rapid succession, each spot being relieved before the other was involved. Another exclaimed on the removing of an instrument, 'Doctor, you hurt me.' 'Where?' 'At the top of my head.'"

Today that sounds not unlike an advertisement for some patent cure-all, but when we consider that operations in 1860 of even a minor character were fraught with grave risk, it is not hard to find a reason for their enthusiasm, and should indeed make our indications most modest indeed.

The word "pessary" is an old one, being derived from the Greek *πessós* and designating a curved stone that was used in playing a game something like our shuttleboard. Later it was used to designate a plug of wood or lint, steeped in medicinal substances to be introduced into the vagina or anus, etc. This definition still holds good for our medicated pessaries, and, at a still later date, to designate a support for the weakened pelvic structures.

In what type of case is the pessary

indicated? Broadly speaking, any type of case in which the pelvic support is inadequate, allowing in turn the uterus to depart from its own anatomical integrity or the bladder to herniate.

These cases can be further classified as:

1. Constitutional.
2. Acquired.

And in passing will say that it is from the latter that the larger number of cases are obtained.

Remembering the afore-mentioned broad classification, remembering that the pessary is but a support for the most part, but seldom producing a cure, we must limit our indications to those cases on whom a permanent cure (operative?) is not advisable:

1. Constitutional causes, such as old age, debility, tuberculosis, etc.
2. Marital, because an operation may interfere with the patient's fertility (post-operative inflammation), but more important pregnancy will most often undo what an operation has done, therefore necessitating another operation. And while we are remembering, *note*: that operations, of this type carry a definite, small to be sure, mortality, not speaking of morbidity with its often invaliding results.
3. Those who refuse operations.
4. Therapeutic.

Before passing to a consideration of the cause and the type of these anatomical deviations, it is well for us to keep some simple picture of the anatomy concerned, and I have borrowed from Crossen's "Operative Gynecology," as epitomizing this subject most clearly and briefly:

The pelvis is spanned by two planes of supporting tissue, one above the other. Each plane is attached to the pelvic wall practically all the way around, so that it forms a fibro-muscular diaphragm with sling action transversely and diagonally as well as antero-posteriorly.

The lower plane or diaphragm lies principally below the vagina and consists of the levator and muscle of each side, with its fascial sheath formed by the recto-vesical

fascia above and the anal fascia below, and supplemental muscular and fascial structures in front and behind. Of the three openings through this fibro-muscular support, the rectal opening is well protected by the sharp bend in the canal and by the superimposed sphincter muscles below, while the urethral opening is protected by the narrowness of the canal and its situation immediately under the resisting bony arch. The vaginal opening is the weak area in the pelvic floor. Under normal conditions it is fairly well protected (a) by its situation, well forward, out of the line of direct pressure; (b) by the direction of the canal being such that intra-abdominal pressure tends to close it instead of open it; and (c) by the overlying upper fibro-muscular plane and body of the uterus.

The upper plane or diaphragm lies above the vagina and comprises two segments—the uterine segment and the vesical segment. Each segment consists of a viscus and its surrounding supports. The uterine supports in the upper plane are (a) the broad ligaments, laterally, (b) the utero-sacral ligaments, posteriorly, (c) the utero-pubic fascial plane, anteriorly, and (d) the fibres between these, extending diagonally from the uterus to the pelvic wall and completing the fibro-muscular diaphragm. Each broad ligament contains an upper and a lower band or condensation of supporting tissue (connective tissue and scattered muscle fibres). The lower collection, extending from the cervix outward and upward to the pelvic wall near the "white line," is much the stronger of the two. In fact, it is so important that it has been called the "ligamentum cardinale" of the uterus. The bladder supports in the upper plane are the utero-pubic fascial plane and the banks of this tissue extending from the bladder to the uterus and to the broad ligaments along the ureters and to the pelvic wall and to the pubic bones. Both the uterine and vesical segments receive support, also, from the intact lower plane.

In addition to these two strong supporting planes, which directly resist intra-abdominal pressure, there is another factor which has much to do in maintaining the integrity of pelvic support. The factor is the deflecting mechanism, by which the force of intra-abdominal pressure

is deflected from the weak area and distributed over the supporting planes. This mechanism depends upon the normal

the same, and thus still further providing against protrusion at the vaginal orifice.

When the pelvic floor has been torn



FIG. 2.—Introducing pessary. Index finger is passed to top of posterior end, which is then depressed until it can be pushed past cervix, as shown in Figure 3. (From Crossen's "Diseases of Women," C. V. Mosby & Co.)

anterior position of the corpus uteri. When the uterus is displaced backward, the deflecting mechanism is disarranged. This is one reason for the importance that attaches to backward displacement of the uterus. Aside from the symptoms caused by retrodisplacement and its complications, there is this disarrangement of the deflecting mechanism, which, in the child-bearing woman, usually leads to serious loss of support sooner or later. With the uterus in normal position, the intra-abdominal pressure is received on the posterior surface of the organ and distributed over a wide area of the supporting planes. Even though the vaginal opening has been enlarged and weakened considerably, it is protected from the abdominal pressure by the broad, firm deflecting surface just above. The greater the pressure from above, the more firmly is the protecting corpus uteri pressed over the opening. Again, as the corpus uteri is pressed downward and forward the cervix is pushed backward, putting the vaginal walls on the stretch and approximating



FIG. 3.—Introducing pessary. Posterior end depressed and being pushed past cervix. (From Crossen.)

and the uterosacral ligaments stretched so that the cervix comes low and the corpus uteri goes back, the whole mechanism, by which the intra-abdominal pressure is resisted by the two planes, is disarranged and the uterus and bladder and anterior rectal wall are gradually forced down.

In reviewing the causes of these anatomical deviations, we find but few, but these few are very definite: (1) Constitutional: Almost any condition that causes weakness and asthenia. (2) Increased intra-abdominal pressure: Occupation, play, cough, corsets, binding after delivery, sub-involution, tumor and cysts, trauma, etc.

1. Constitutional. Consult an internist to determine whether the so-called constitutional weakness is a necessity or not.
2. Increased intra-abdominal pressure.
  - (a) Occupational. Needless to say, in advising a patient to change her occupation, it is with the knowledge that even an operation offers no guarantee of a permanent cure.
  - (b) Play. Discontinue.
  - (c) Cough. It would be indeed folly



to treat a pelvic condition, perhaps a minor one, without determining the cause of a persistent cough, for here often many of the symptoms complained of, despite a departure from a normal anatomical integrity, will be remedied by curing the cough, thus stopping the unceasing change in pressure to which a chronic cough subjects the pelvis.

(d) Constipation. One could write at length, even though at variance with some of our leading gastroenterologists, but bear in mind that the pelvic organs are in intimate association with the sigmoid and upper rectum, and despite the fact that no constitutional ill-effects may be detected at times from the constipation, yet the pelvic distress may be due in part or in whole to this very thing. Also, constipation usually means straining at stool, and thus a marked increase in intra-abdominal pressure is brought about.

(e) Corsets. The passing styles indeed can play a part, as it is rumored that with the event of the long skirt, corsets with bones (and they allow less play than the others and caused increased intra-abdominal pressure) are essential to produce the true "feminine lines." A short time ago the "boyish figure" was the approved style.

(f) Binding or tight girdles after parturition. But rarely and then only where the integrity of the abdominal wall has been destroyed is there any indication for such treatment. Postpartum exercise early and late is the best method to insure a good abdominal wall, and in turn aid in the proper involution of the uterus.

(g) Subinvolution. The cause: usually lack in postpartum attention, such as exercise, posture and

a proper appreciation of the size the uterus should be, and, the speed at which involution should proceed.

(h) Tumors and cysts. Little can be done to avoid these complications.

(i) Trauma save obstetrical. Rarely due to other than operative trauma. In many of the minor gynecological operations it is the method to grasp the upper and lower lips of the cervix with tenaculæ, and that is where their function should cease, simply to fix the cervix; but it is the habit with many operators to drag on the cervix, thus pulling it, and, of course, the fundus as near the valva opening as possible. This dragging may definitely and permanently impair the pelvic support.

(j) Obstetrical trauma. Despite the fact that some authorities say parturition is a pathological process, we still feel that "intelligent watchful waiting" is another aid in our prophylaxis against the solution of normal pelvic continuity.

Thus in a brief review of the more common causes of these departures from the normal we see that much in a prophylactic way can be done by proper advice, instruction and technic.

With what anatomical deviations are we concerned? Briefly, those in which the axis of the uterus has been changed and where the level of the uterus, i.e., the body and cervix, departs from normal; deviations of the uterine axis as a whole and not as a part, i.e., versions of the uterus and not flexions; the level of the uterus as judged by the tip of the cervix resting on a line joining the spines of the ischium or on an arc drawn therefrom. Naturally, there are exceptions to these rules, but on the whole they will serve as a guide.

We have previously stated "which allows the uterus to depart from its own anatomical integrity." This statement has been made advisedly as it is in the depar-

ture of the uterus from its congenital position to a new position that produces, as a rule, pelvic pathology and symptomatic distress.

By various authorities the position of the uterus is stated to be retroverted in 16 per cent to 18 per cent of all virgins and for these patients that position is considered as one of normal anatomical integrity. Furthermore, in these cases of congenital retroversion, discovered at examination and not an etiological factor in the patient's history, no attempt should be made to correct that which is normal for that patient.

We see then that our pessary is even further limited by this fairly large type of cases, and so it is, for the most part, in the acquired retroversion from whatever cause save tumors, in antiversion with early descensus and in all types of descensus and herniation of the bladder that the best results are obtained in the use of the pessary. The pessary in these cases acts as a support and by allowing a return of normal circulation, relieving the strain on muscle, fascia and connective tissue, tone is enhanced, involution or repair aided, and a cure at times effected.

Let us digress a moment to view in our mind's eye this action. If we draw a plane of the upper pelvis on a level of the anterior vaginal wall, it has somewhat the appearance of a pear cut in its long axis. If we view it on the side, it has the appearance of the letter "s" placed in a lateral position with its curves lengthened. If the pelvis is again viewed in coronal section, we see it has somewhat the shape of a "v." This is due to the levators, and it is the levators that support the pessary, and it is on the integrity of the levators that we depend for the final support transmitted through the pessary. On the other hand, in using a pessary of the horse-shoe shape the action of the levators is not only one of clasping and supporting, but also of buttressing.

For the most part, we favor the shape of the Hodge or Gehrung after one has

modified it to the pelvis in consideration. Both can be bought in various sizes, but, because each vagina varies in length, breadth, and symmetry (depending on the integrity of the levators), we favor the shaping of each pessary at the time of introduction, hence, each pessary should bear the imprint of the doctor using the same.

That the symmetry of the pelvis is important can be easily ascertained by examining a patient after a labor. We may find one side fairly normal, the other presenting definite indications of the disruption of the levators. Naturally, if a pessary is introduced without proper evaluating, this observation, it may prove a complete failure, so it is by considering each vagina to be fitted as an entity, distinct, separate and different, in that way alone will the pessary prove a success. It is true that a stock pessary may prove efficacious, but the converse is equally true.

In order that the best results may be obtained, we advocate the use of the hard rubber pessary, and keep in stock various sizes of the simple round variety. This is advised as hard rubber is the only material that is easily shaped, cheap, smooth, and, if properly cleansed, seldom shows the action of corrosion.

After an examination, at which time the use of the pessary is decided on, two or three pessaries of varying sizes are placed in boiling water (sterilizer) and allowed to soften, and then while soft bent to the required size, immediately placed in cold water, when they will harden at once. The length is best judged in the same manner that we seek to find the diagonal conjugate i.e., by introducing the first and second finger to the posterior fornix and measuring from the subpubic ligament. The width only by trial and experience.

It must be remembered that often several trials are necessary with alterations in shape and size before the ideal is attained, and the ideal pessary must fit and perform

the function assigned to be a success. Furthermore, the ideal pessary will not cause pain or distress, in fact, the patient should not be conscious of its presence and it should not interfere with normal marital relations.

The diagrams show us roughly the shape of the two pessaries in question. The first is best introduced in the oblique diameter of the outlet. After lubricating the pessary, the perineum is depressed with one or two fingers of the left hand, the pessary held in the right at the narrow anterior bar, and then inserted in the oblique diameter, so that the anterior arm will pass to the left of the urethra while the posterior arm will press down and fit in the groove formed by the union of the perineum and the right vaginal wall. Pressure down is made, and the pessary is forced gently forward until the resistance of the pelvic floor is overcome when it is gently rotated, bringing the anterior bar down and the posterior bar up. The cervix should pass over the posterior bar, in other words, lie in front of the posterior bar. Sometimes it will be found that the cervix is posterior, and then it is necessary to depress the posterior bar with one or two fingers in the vagina until the posterior bar slips behind the cervix. Your pessary is now clasped or supported by the levators, the lateral vagina walls are rendered more tense, and at the same time the utero-sacral ligaments are rendered taught and tend to pull the cervix posterior, displacing the fundus anterior. One can easily understand that with the uterus in position herniation of the bladder will also be aided, as the facial sheath that supports the bladder will be rendered more taught and the two arms of the pessary will act as a support or scaffolding.

The Gehrung pessary is easily fashioned from the round type previously mentioned. This is done by approximating two opposite points on a softened pessary. If now it is bent in the middle of its long arms, we obtain the shape of two horseshoes placed a few centimeters

apart and joined at the corresponding point or its fellow. This pessary can be bought in various sizes, but with different cases so must this pessary vary, in height, in width of the two arches and the symmetry of the same. This pessary is used to its greatest advantage in herniation of the bladder, to a much less degree in early descensus. Its action is one of support of the bladder, and acts directly at the site of the torn or stretched bladder support. This pessary depends not only on the grasping action of the levators, but also is buttressed against some bundle of muscle fibers. This pessary is introduced by depressing the perineum and at the same time inserting the left heel as far as it will go easily. It is then carried posterior, and during the whole time of its introduction is rotated in a corkscrew manner so that when the heel is at rest, it will lie opposite its fellow, but on the right side, thus bringing the two arches of the pessary directly under the bladder.

In the use of the pessary, we are striving to correct anatomical deviations. There is little to be said in a controversial manner in regard to the first three indications, i.e., constitutional, marital, those who will not be operated on, but what of the fourth, therapeutic? In evaluating slight digressions of the uterus from the normal, one is at once struck by the seemingly contradictory findings. In the one case a patient with definite retroversion and prolapsus may offer no complaint, while on the other hand, one with what seems but slight laxity of the uterine support, the tip of the cervix being just below the line joining the ischial spine, may present a number of symptoms varying from pelvic complaints to definite neurological symptoms, and it is in such cases that lifting and supporting the uterus with a pessary will prove whether that is the exciting cause of the symptoms.

In order that I may illustrate this important feature, I will briefly review 2 cases. The first one complained of persistent diarrhea that had existed since the

birth of her last baby some twelve months before. It was the one symptom complained of. She was seen in the clinic after passing through various other departments without relief. The finding was just one, a uterus anterior with a departure from its normal level. Rectal examination revealed the fact that the cervix was invaginating the anterior rectal wall. A pessary was tried. The diarrhea was stopped.

Another woman presented herself at the clinic, after having been reviewed by the other departments and labeled with a diagnosis of neurasthenia. Her complaint was pain at the base of the skull and upper cervical spine. The findings here were a simple departure of level. A pessary was tried, and the patient returned without the pain. She is still under observation as she is in the child-bearing age and desires more children. The recital of these 2 cases may sound extreme, but it is only by trying, in cases where there is but slight and early departure from the normal, that we are able to evaluate a simple, single clinical finding.

The "do nots" are important in the use of the pessary. Do not insert a pessary with the uterus retroverted and expect the pessary to right the condition. First correct the retroversion manually, and if it is not correctable, it is not a case for a pessary.

Do not use a pessary in the presence of pelvic inflammation.

Do not use a pessary in the presence of vaginal inflammation.

Do not use a pessary to correct a malposition caused by tumors or cysts.

Do not allow a pessary to remain that causes pain.

Do not forget with the presence of prolapsed tubes and ovaries the pessary is not to be inserted.

Do not forget that proper exercise: knee, chest, monkey-trot, etc., is indeed an added aid.

Do not forget that when the pessary is in place the tip of the finger should be able to pass easily between the supporting arms and the vaginal walls.

Do not forget that a warm cleansing douche should be taken every day except when the patient is menstruating.

Do not forget to see your patient two weeks after the first introduction of a pessary.

Do not forget that a pessary should be removed and cleansed at least every six weeks. Do not forget that at the time of its removal, if signs of pressure are present, that it must be discontinued until such signs are absent (such signs are for the main visual); and, in conclusion, do not forget the words of the late Dr. Emmett: "The great cause of failure and disappointment in the use of pessaries lies in the fact that the vagina is expected by many to adapt itself to any instrument which may be introduced, when, in fact, it is essential that the peculiarities of each individual case should be studied."



## WET & DRY DRESSINGS WHEN & HOW TO USE THEM\*

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**I**N general we are called upon to treat two kinds of wounds: clean wounds (clean in the sense that there have been relatively few organisms penetrating the skin) and those that are frankly suppurative. Cuts and lacerations, if seen

in the first twelve hours, should be regarded as clean wounds for the purpose of selecting a dressing, as a very large majority should heal without suppuration. These wounds are not bacteria free but the number of bacteria is so small that normal tissue

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reaction is able to destroy the few present without the formation of pus. In applying a dressing, the surgeon can act only to prevent the invasion of more organisms from without, and to so support the tissue that bactericidal action can take place to the maximum degree. Rest to the part and heat for dilatation of blood vessels are our best agencies for the latter.

There are four major requirements for the multiplication of bacteria; namely, the organism, a media, moisture and heat. Lacking any one of these, the process does not occur. Body heat and tissue media are always present in wounds. If we attempt to reduce the number of bacteria by drugs or by washing out the wound we are seldom successful in materially eliminating them. We can, however, render the wound relatively dry. It is the most satisfactory point of attack. Dressings which prevent the invasion of more bacteria and will absorb the greatest amount of moisture and continue to do so for the longest period should be selected. We therefore use ordinary gauze. Its capillarity removes moisture and passes it to the outside where it evaporates. Any covering over gauze preventing evaporation and continuous dehydration of the wound destroys its greatest value as a dressing. Too frequently we cover a gauze dressing with so much adhesive, oil-silk, wax paper, cotton or fiber pads that absorption is insufficient to keep the wound dry and a typical incubator is produced, bacteria multiply, and maceration occurs. If additional heat is desirable to increase the vascularity in these dry wounds, it can better be applied by the use of the hot-water bag, electric light or electric pad than by impervious coverings.

I think we should consider our drugs in much the same light. Those that destroy bacteria without devitalizing normal tissue cells and at the same time inhibit their growth by dehydration or isolation are of the greatest value. In the possession of these properties, for instance, lies the value of tincture of iodine.

Just as we should attempt to keep wounds free from suppuration by properly applied dry dressings, if pus does form it must be removed from the scene of action immediately. Our gauze dressing will absorb pus as it does moisture, but to a much less degree. Either the dressing must be changed frequently or we have again the typical incubator at body temperature. It is impracticable to change dressings often enough to keep wounds dry so we substitute wet dressings in an attempt to dilute the pus and make it more absorbable. This type of dressing is only a makeshift for a more complete removal of the products of bacterial action, by irrigation or soaking, because it can be used as an ambulatory measure. Usually the dilution is sufficient to allow the regenerating tissue cells to throw off the invading bacteria. Many solutions are advocated and are of value as they promote an interchange of fluid with the pus discharge, and actually accomplish dilution. Perhaps some solutions are bactericidal, but I believe this action is secondary to the principals of drainage. The use of an impervious covering for wet dressings, while it protects the clothes and keeps the dressing moist for a longer period, too frequently produces a "poultice" action in practice in which the temperature of the part is raised, secretions retained, and suppuration speeded up.

It is better to give the patient a bottle of solution to keep his dressings constantly wet than to retain moisture by impervious coverings.

Where the skin is not broken, as in contusions, sprains, etc., relief is usually secured by any type of heat. The extravasated blood and broken-down tissue are carried away through the blood and lymphatic streams. Heat promotes this absorption. Hot wet dressings give an excellent distribution of heat and there can be no objection to impervious coverings. Here, however, it is heat which is of value rather than the wet dressing.

Low-grade infections, paronychia, lym-

phangitis, infected hair follicles without suppuration, etc. may be treated in the same manner. Again, heat can be well applied through the agency of the wet dressing just as it can through hot solutions, the hot-water bottle or the electric pad.

In suppurative processes such as boils, abscesses, suppurative tenosynovitis, etc., where the skin is still unbroken and the infection not localized, a hot, covered wet dressing not only acts as a "poultice" to localize the infection but also softens the skin and helps the process to point. After drainage has been secured either by natural or surgical method, as already

suggested, the wet dressing should be left uncovered.

In selecting a wet or dry dressing for any lesion one must decide just what is to be accomplished, whether it is protection from more infection, dehydration, removal of bacteria present, a "poultice" action or simply support of the body resistance by the use of heat. For the most part, if dressings are to be dry they should be kept very dry. If wet, they should be very wet and be kept wet. If compresses or "poultices" for walling off infections through the agency of heat are required, use them but do not make an incubator out of an infected wound by sealing the dressing.



## OFFICE LABORATORY FOR THE SURGICAL PRACTITIONER\*

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WITH the development of laboratory practice, its importance and necessity in diagnosis and treatment, and the opportunities for postgraduate instruction in the large cities, an increasing demand has arisen on the part of the practitioner far removed from elaborately equipped laboratories for such service. Within certain limitations, as to equipment and training, much of this work can be done in the office. The expense of such equipment and maintenance need not be large. The technical training necessary for the performance of the tests can be easily acquired, and the experience needed to read the results is soon obtained. The practitioner will probably face his most difficult problem in the interpretation of results. The solution here, however, lies in reading and the general knowledge of medicine, and can be learned by him who is willing.

To attempt to differentiate between a

laboratory designed for surgery and one for general medicine, is practically impossible. Since the practice of surgery depends almost entirely on general diagnosis, especially when cases are not referred for surgical treatment after careful study, what is applicable to that specialty, also applies to medicine as a whole.

Therefore, for practical purposes, the description that follows is a general outline of the equipment and procedures applicable to the country practitioner's office, with a few omissions in deference to surgical practice.

The detailed equipment of small articles need not be itemized. They can be enumerated from the descriptions of the tests, where the names and specifications will be mentioned. Any solutions, reagents and equipment here listed may be purchased in surgical supply stores or laboratory specialty houses.

The procedures to be described have

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been carefully selected from the manual of laboratory procedure of the Pathological Department of the Jewish Hospital of Brooklyn, and are described as they are done in that institution, with the equipment as used there. For reference purposes, any one of the following volumes should be at hand: Todd and Sanford's "Clinical Diagnosis by Laboratory Methods;" Webster's "Diagnostic Methods;" Vogel and Famulener's "Laboratory Methods," or Haden's "Clinical Laboratory Methods." The interpretations and significance of the tests will not be discussed.

Extensive bacteriological examinations cannot be attempted for obvious reasons. Examination of smears, especially for gonococci and the more common organisms, can be done with a minimum of equipment and time. For this purpose the Gram stain is used. With a platinum loop a small amount of the material is thinly spread on a glass slide. The preparation is fixed by passing the slide over the Bunsen flame three times. The slide is then grasped with a slide holder and carbol gentian violet is poured over the smear. After allowing it to remain for a minute, it is poured off and replaced with Lugol solution. This is again poured off and alcohol 95 per cent is dropped on it until the violet color has disappeared. The slide is washed in tap water and stained for a minute or two with solution of basic-fuchsin. It is then blotted, dried, and examined with the oil immersion lens. The Gram-positive organisms appear black or deep purple in color. Streptococci and staphylococci are easily identified by their characteristic groupings. Gonococci are red, occur in pairs, are coffee-bean shaped and frequently are found within the leucocytes.

The examination of urine often yields information of considerable value to the surgeon. The examinations which follow are within the scope of usual office practice:

#### URINE

*Albumin.* Test for albumin by filling a  $5 \times \frac{5}{8}$  in. test tube three-quarters full

with urine. The upper portion of the specimen is boiled over the Bunsen flame, 3 drops of 2 per cent acetic acid are added and the boiling is repeated. The density of a precipitate is noted and recorded as follows:

No Turbidity: negative.

Slight turbidity: very faint trace.

Next degree of turbidity: faint trace.

Then: trace.

Then: moderate trace, heavy, cloud, or solid.

*Sugar.* The quantitative estimation of sugar is conveniently done by pouring 5 c.c. of quantitative Benedict's solution into a  $6 \times \frac{3}{4}$  in. lipped test tube. The solution is boiled over a Bunsen flame, and while boiling, urine is added drop by drop from a Mohr 1 c.c. pipette graduated in 0.01 until a white precipitate appears. The amount of urine used contains 0.01 gm. glucose. The percentage of sugar is obtained by dividing 1 by the volume of urine used. Thus, if 0.5 c.c. of urine was used,  $\frac{1}{0.5} = 2$  per cent.

*Indican.* Equal parts of Obermeier's reagent and urine are mixed in a  $5 \times \frac{5}{8}$  in. test tube. To this is added 1 c.c. of chloroform. It is gently but thoroughly mixed and allowed to stand for a few minutes. A blue color of the chloroform which settles to the bottom indicates the presence of indican.

*Acetone.* With the aid of heat, dissolve 1 or 2 crystals of sodium nitroprussiate in a few drops of water in a  $5 \times \frac{5}{8}$  in. test tube. Add 5 c.c. of urine and a few drops of glacial acetic acid and shake thoroughly. Over it layer carefully 1 c.c. of ammonia. A purple ring at the line of contact denotes the presence of acetone.

*Blood.* In a  $5 \times \frac{5}{8}$  in. test tube dissolve a few crystals of guaiac resin in 1 c.c. of 95 per cent alcohol. To this add 10 c.c. of urine and 1 c.c. of hydrogen peroxide and shake. A green color indicates a positive reaction.

#### GASTRIC CONTENTS

*Acidity.* Examination of gastric contents should always be performed as soon

as possible after specimen is received. The appearance of the specimen should be noted and fresh particles of blood should be looked for. The specimen is then filtered through gauze. To 10 c.c. of filtrate add 1 drop of Toepfer's reagent. A red color denotes free hydrochloric acid. From a 50 c.c. burette graduated in tenths, add decinormal sodium hydrate solution drop by drop until the color becomes a canary yellow. The amount of the solution added, multiplied by 10, represents the percentage of hydrochloric acid in terms of normal hydrate solution. To the same filtrate now add 2 drops of 1 per cent phenolphthalein solution. Continue to add sodium hydroxide solution until the solution changes from yellow to red. This reading times 10 plus the percentage obtained for free hydrochloric acid, represents the total acidity in terms of normal sodium hydrate solution.

*Lactic Acid.* To determine the presence of lactic acid take 10 c.c. of water in a  $5 \times \frac{5}{8}$  in. test tube. One drop of 10 per cent ferric chloride solution is added. Shake thoroughly. To this add 2 or 3 drops of filtrate. The presence of lactic acid is then indicated by a bright canary yellow color.

#### BILE IN FECES

Bile is detected by mixing feces with saturated solution of bichloride of mercury and allowed to stand over night. A pink color denotes bile. The feces should be examined for red blood cells, white blood cells, ova, and parasites, microscopically.

Examination of feces for blood is done as for the urine.

#### BLOOD

It is scarcely necessary to describe in detail the methods for counting blood cells. In surgical practice however, there are certain examinations that should be done and in the opinion of the writer are of great importance.

*Bleeding Time.* The lobe of the ear is pricked and the time is noted; the piercing

being done with a sharp needle. The blood is removed as soon as it accumulates, by lightly touching the tip with ordinary blotting paper. The time that the bleeding stops of its own accord is noted. The period of time between the beginning and the cessation of bleeding is known as the bleeding time. The normal bleeding time is one to two minutes.

*Coagulation Time.* This is best determined by the use of a capillary pipette which can easily be made from ordinary glass tubing about 4 mm. in diameter, the tubing being heated in the Bunsen burner and drawn out while hot. The blood is collected in such a capillary pipette about 6 cm. long from a finger tip puncture, and the time is noted. This pipette is then gently broken at one minute intervals and time of first appearance of the clot is noted. The difference in time between the finger puncture and the first appearance of clot is noted as coagulation time. Normally, by this method, it is up to nine minutes.

*Blood Sugar Estimations.* Blood sugar estimations can be conveniently done by the micromethod, as described by Kramer and Gittleman. The blood is drawn from the finger tip into a special pipette (marked 0.1 c.c. to 0.2 c.c.) up to the 0.1 c.c. mark and expelled into a  $4 \times \frac{1}{2}$  cm. test tube graduated at the 2 c.c. mark and containing 1.5 c.c. of distilled water. The pipette is washed by drawing and expelling the solution several times. One-tenth cubic centimeter each of sodium tungstate solution (10 per cent aqueous) and two-thirds normal sulphuric acid are added. The contents are mixed by rolling the tube between the hands until the mixture changes to dark brown. The volume is then brought to 2 c.c. with water and mixed. It is allowed to stand for five minutes and centrifuged for two to three minutes. To 1.5 c.c. of supernatant fluid add 2 c.c. of copper solution in a sugar tube. Prepare the standard in a similar manner. Put both tubes in boiling water bath for six minutes and then cool. To each tube add 2 c.c. of phosphomolybdic



solution followed by water up to 12.5 c.c. Set standard at 15 and read in colorimeter.

Calculation is  $\frac{S}{R} \times 0.1 \times \frac{1000}{7}$  mgm. per c.c.

S = reading of standard. R = reading of unknown.

The reagents, including the standard dextrose solution mentioned, may be purchased prepared for use and are stable. The assembled apparatus for this method is supplied by laboratory supply houses.

*Icterus Index.* The icterus index is done on the blood serum. About 10 c.c. of blood are collected in a test tube, allowed to clot and the serum is carefully pipetted off. The depth of the color of the serum is compared to a standard consisting of potassium dichromate solution, 1:10,000 in water, in any standard colorimeter. Should the serum be of a much deeper color than the standard, suitable dilution with water must be made. The result is obtained by dividing the reading of the serum by the reading of the standard and multiplied by the dilution, if any is made. The normal varies between 5 and 6.

*Rosenthal Test for Liver Function.* Blood is drawn off and serum is collected. Through the same needle the necessary quantity of bromsulphalein is injected, according to directions on the box. Fifteen minutes later, and one hour later, specimens of blood are again withdrawn from the vein. The serum is allowed to separate and is pipetted off. To each of the three specimens of serum, 1 drop of 5 per cent sodium hydrate solution is added. A purplish discoloration denotes the presence of dye. Normally, the first tube should contain no dye, the second tube very little if any, and the third, none.

*Phenolsulphonephthalein Test for Renal Function.* After the patient has emptied the bladder, he is given 8 oz. of water to drink. Using a 1 c.c. Luer syringe, 1 c.c. of phenolsulphonephthalein (supplied ready for use in ampules) is injected into the cubital vein of the arm, or into the gluteal region intramuscularly. Exactly one hour

later, the patient voids. He is given two glasses of water to drink at this time. One hour after this, he again voids. Both specimens are alkalinized with 10 per cent sodium hydrate solution and the volume is brought up to 1000 c.c. with tap water. The percentage of dye is estimated in the colorimeter. If the injection is intramuscular, the urine specimens should be collected one hour and fifteen minutes and two hours and fifteen minutes later.

*Carbon-dioxide Combining Power of Blood.* The estimation of the carbon-dioxide combining power of the blood can be done easily by means of the portable apparatus recently described by Fradkin,<sup>1</sup> full directions accompanying the apparatus.

*Sedimentation Time of Blood.* The sedimentation time of the blood is estimated by drawing blood from a Luer syringe up to the 1 c.c. marked in a tuberculin syringe which has previously been charged with 0.2 c.c. of 5 per cent sodium citrate solution. The contents are then expelled into the sedimentation tube designed for that purpose. Readings are recorded when the red blood cell column reaches the 16 mm. mark. Normally this occurs within about an hour.

*Iso-agglutination and Mutual Match for Transfusion.* For the determination of the blood group, it is necessary to be provided with serum from a group A(II) and group B(III) individual. On an ordinary slide place separately a drop each of group A and group B serum. To each drop add 1 of the blood of the individual to be tested and mix. Examine after five minutes under the low power microscope. If the red cells are clumped only with the group A serum, the blood is that of a group B individual. If the cells are clumped by the group B serum, the individual belongs to Group A. If the cells are clumped by neither, the individual belongs to Group O. If the cells are clumped by both, the individual belongs to group AB. In the latter instance, auto-agglutination must be ex-

<sup>1</sup> *Lab. & Clin. Med.*, 14: 973, 1929.

cluded. By observing the individual's blood cells without the addition of serum, if there is no clumping, auto-agglutination can be excluded.

*For Cross Matching.* Into a white blood cell pipette aspirate 3 per cent sodium citrate solution up to 0.5 mark. Fill the pipette with blood of the recipient up to the 11 mark, mix and expel all but the contents of the capillary portion of the tube up to the 1 mark, into a  $3 \times \frac{3}{8}$  in. test tube. Expel the remainder into a

similar tube. Expel all the contents of pipette excepting that in the capillary pipette up to the 1 mark, into recipient tube containing the smaller portion of the blood. Expel the remainder of the contents of the pipette into the test tube containing the larger portion of the recipient's blood. Shake both tubes thoroughly. Let stand for ten minutes and on a slide observe under the low power microscope. If there are no clumping in either, the bloods are compatible.



## OFFICE TREATMENT OF URINARY TRACT IN WOMEN\*

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IN THE consideration of the scope of office treatment of bladder, urethral, ureteral, and kidney conditions, one must take into account the magnitude of the procedure, the tolerance of the patient for the treatment itself and the reaction. Also the care she may have after leaving the office. What is well borne by one patient would prove impossible for another. If there is any doubt as to the reaction the patient may experience, the first treatment should be given in the hospital; the reaction to this will serve as a guide to subsequent care.

The patient should be cautioned as to any possible disagreeable after-effects, and instructed as to what to do should they occur. Means of relief, rather than a prescription, should be given, thus avoiding unnecessary suffering while waiting for the medication.

A large part of the office work in urological conditions relates to diagnosis, but this does not fall within the scope of this paper. The subject will be discussed in relation to the kidneys, ureters, bladder, and urethra.

### KIDNEYS

Office treatment of the kidneys is restricted to pyelitis, and stricture of the ureter at the ureteropelvic junction. Dilatation of the stricture at this point can be well carried out in the office, if previous dilatation in the hospital has not been attended by too marked a reaction. For the renal infections, lavage may be as well done in the office as in the hospital, provided ureteral drainage is competent and the condition is not acute. Kidney lavage is not apt to be attended by disagreeable reaction. My best results have been with nitrate of silver, though in the instances where there is moderate hydronephrosis, a water-soluble substance, such as mercurochrome, which does not produce a precipitate with the urine, is in order. It is, of course, understood that a thorough diagnosis has been made and that one is dealing with a simple pyelitis, and not a kidney stone or tuberculosis.

### URETERS

Conditions most frequently requiring attention are ureteral strictures, calculi,

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and intravesical ballooning of the ureter with narrowed orifices.

**Strictures.** The first dilatation should preferably be in a hospital, although it may be performed in the patient's home, or even in the office if the patient is within easy reach of home. Often there is quite a reaction, and the patient may develop acute retention in the ureter and the kidney pelvis from ureter blockage due to the swelling of the ureteral mucosa following instrumentation. This is not so apt to occur in subsequent dilatations. Dilatation should be done in a gradual manner, and no attempt should be made to reach the maximum at one treatment. By using dilators of an increasingly larger caliber, at intervals of four to seven days, the dilatation may be carried up to 9, 10, or even 14 F., with little or no reaction and only slight discomfort. Until one sees what reaction is experienced the patient is directed to go to bed, apply heat for pain, and to have codeine, or if necessary, morphine, in doses sufficient to relieve.

**Stone.** This is usually best treated in the hospital, though occasionally it is justifiable to pass a catheter or bougie as an office measure, to change the position of the stone, to loosen it when adherent, or to dilate the ureter below the stone. While I have fulgurated the mucosa over a stone impacted in the lower end of the ureter, in the office, I feel it is a bit too much except in cases of phlegmatic individuals who tolerate pain well. It is difficult to get anesthesia by any of the methods that can well be considered office procedure. The same applies to the cutting or fulguration of the ureter that balloons intravesically.

#### BLADDER

The most usual condition encountered here is inflammation. While many feel that bladder inflammation is nearly always associated with renal infection, urethral obstruction, or foreign bodies, I am convinced that most of the bladder infections

which come under my observation are primary in the bladder and not complicated with obstruction or kidney infection. For these, lavage with boracic acid solution, followed by the installation of argyrol, combined with urinary antiseptics, gives good results. Rest in bed is important though not absolutely essential. Hot vaginal douches often afford relief. For the first few days a sedative, such as tincture of hyoscyamus with potassium citrate, is given. Of the urinary antiseptics, urotropine and pyridium have been the most effective I have found. Except with an alkaline urine, the acid sodium phosphate should not be given with the urotropine, as it sometimes produces a very marked irritation and an exaggeration of the cystitis. Frequently hematuria, of vesical (or renal) origin, is produced. In some of the more stubborn cases silver nitrate, 1:10,000 to 1:2,000 is more effective than the argyrol.

The Hunner type of ulcer is best treated in the hospital by fulguration under spinal anesthesia, with subsequent office treatments consisting of the installation of argyrol, rivanol 1:5,000, or nitrate of silver 1:500. Some of the more simple ulcers may be sufficiently anesthetized with 5 per cent cocaine, to lightly fulgurate or to touch with silver nitrate stick, with patient in knee-chest posture.

Small foreign bodies may be removed either through the water type of cystoscope or the Kelly endoscope.

Certain papillomata may be fulgurated with little discomfort. There is almost no pain to this procedure until the base and the vesical wall are treated. If the growths are large or numerous, the fulguration is more satisfactorily done in a hospital with the patient anesthetized.

The most frequent, and one of the most troublesome, conditions encountered is cystitis coli, or inflammation localized in the trigonal area, often extending into the urethra. This is best treated by urethral dilatation to 30 or 35 F. and applications of 5 to 10 per cent silver nitrate to the trigonum and urethra,

through a Kelly endoscope with the patient in the knee-chest posture. Previous applications of cocaine to the urethra and bladder makes this only slightly uncomfortable. The reaction is not often of any great moment; though there may be urgency and frequency for an hour or more. This treatment may be given every five to seven days.

#### URETHRA

Urethritis, stricture, papillomata, caruncles, and skenitis may all be treated in the office.

*Urethritis.* Acute urethritis is most often due to the gonococcus. In the acute stage of the infection rest, alkalies by mouth, and hot vaginal douches are indicated. After the condition subsides to some extent, argyrol is injected once or twice daily. When it is impracticable for the patients to come to the office for these treatments they have been instructed in the injecting of the argyrol themselves. It is not a difficult procedure for them and I have seen no harm result. The condition has cleared up much more rapidly with the frequent treatments. In chronic urethritis the best results have been obtained by the application of 5 to 10 per cent nitrate of silver through a Kelly endoscope, with the patient in knee-chest position. If there is any evidence of urethral stricture, the urethra should be dilated to 35 to 37 F. Treatments are given every five to seven days. A cystitis coli, or trigonitis, is often present at the same time and should be treated with applications of silver to the trigonal area.

Skenitis is a frequent accompaniment of urethritis and usually clears up as the urethritis improves; but at times the infection becomes chronic in the glands and their ducts. With a suitable speculum (skenoscope) and a small probe-pointed cannula these ducts may be injected with

an antiseptic solution. Argyrol works well if the infection is not of too long standing. If a destructive action is desired strong silver nitrate or carbolic acid may be used. Some may require incision and the application of pure silver nitrate, or the galvanocautery. Electrocoagulation may be used but the degree of destruction is difficult to determine and may result in too much tissue being destroyed.

*Papillomata.* These are not uncommon in the urethra and should be fulgurated through one of the modifications of the Kelly endoscope with the patient in the knee-chest posture. Cocaine anesthesia, brought about by the application of a 5 per cent solution of cocaine, is usually sufficient.

*Stricture.* While not as frequent as in the male, more cases are encountered than is usually thought. Many are of large caliber, and while not usually sufficient to cause retention of urine, often interfere with the healing of a chronic urethritis. They may be detected with a bougie a boule. Often there is a contracture of the external meatus, especially in older women. Rarely does one meet a tight, fibrous stricture. Except for those at the external meatus, dilatation, done gradually, and at a number of sittings, is sufficient. There is a tendency to recontraction and repeated dilatations at intervals of 2 to 6 months may be necessary. For the contracted, external meatus, incision, under infiltration anesthesia, may be required.

*Caruncles.* These are best removed by the Oudin or desiccating current. For large ones, where deeper destruction of tissue is required, carefully controlled electrocoagulation may be indicated.

Again I wish to emphasize that while many procedures are possible in the office, only those which can be well tolerated by the patient should be done; also that provision be made for any reaction which may occur as a result of treatment.



# SURGICAL CONDITIONS OF THE EYE\*

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**S**URGICAL treatment of conditions of the eye can be employed safely in office practice if precaution against infection is used. Asepticism, as it is employed in modern operating rooms, should also be used in office practice rather than antisepticism; this will permit uninterrupted healing of wounds. Antiseptics in mild solutions do not materially interfere with healing of clean wounds and sometimes the use of strong solutions, topically applied, prevents the spread of infection from wounds that cannot otherwise be made surgically clean, without delaying healing further than the time necessary for the sloughing of necrosed tissue. As a false sense of security may be engendered by faith in the antiseptic properties of solutions usually employed in ophthalmic surgery, they may better be used sparingly, and as adjuncts, rather than as primary agents. A high degree of asepsis can be attained by copious irrigation of the eye with neutral, or slightly alkaline, solutions so that minor injuries and small surgical wounds can be adequately cared for. The skin and conjunctiva naturally harbor organisms, most of which are not pathogenic and do not penetrate the epithelial layers. Such organisms are easily caught in the mucous secretion of an irritated or inflamed eye and are carried away with the secretion. A convenient method of irrigating the eye in office practice is by a solution of boric acid in a common wash bottle which can be sterilized daily and can be kept filled with a freshly prepared and sterilized solution.

The conditions of the eye for which surgical treatment can be used affect the lids, conjunctiva, lacrimal apparatus, and cornea, in the relative frequency of the order in which they are named. In industrial practice, in which eye hazards are

increased by exposure to injury by fragments of metal and of wood, affections of the cornea are, of course, more common. But most of such corneal lesions are minor and do not require procedures that would be classified as surgical.

## AFFECTIONS OF THE LIDS

*Sty and Chalazion.* The common sty, an inflammation of one or more of the sebaceous glands of the eyelid, is the most frequent condition of the lid which one is called on to treat. The onset is insidious, with edema, and tenderness of the lid; a sensation of foreign body in the eye is the chief complaint. The appearance of the lid is characteristic. There is a center about which the swelling occurs, usually pointing early in the course of the inflammation to the gland affected. The swelling of the lid is not uniform, differing thereby from the swelling seen in deep-seated conditions of the eye or orbit, or in constitutional disorders. Several glands may be affected at one time, with marked swelling and tenderness of the lid, and even with fever with toxic symptoms. The confluence of several purulent pockets may spread to cellulitis of the lid, with marked infiltration of the deeper structures of the orbit. More often, however, the affection is seen as multiple stys recurring along the margin of the upper and lower lids, first on one eye, then on the other, sometimes continuing for several months in spite of treatment.

Medical treatment of stys will not be considered in this article, but it must be made clear that the sty is an acute inflammation and should be treated as such to prepare the way for operative procedures if such should become necessary.

Not often does the infection extend beyond the lid. Complications are rare.

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Usually the gland breaks down and a purulent cyst will point at the margin of the lid. Spontaneous rupture will be followed by prompt healing, without a visible scar. However, indolent stys occur that do not rupture spontaneously, but remain as cystic swellings. Edema and tenderness may not have been noticeable. After several weeks the tumor may disappear, leaving a small, cord-like, palpable body, or it may remain for months without noticeable change. Such a lesion is usually referred to as a chalazion.

During the acute stage of inflammation a sty should not be opened. It is contrary to good surgical practice to open into a region of acute inflammation. Under normal conditions an abscess with a protective wall will form, which will open spontaneously or which may be opened into or excised. The more acute stys should be allowed to run their course with non-surgical interference. After the subsidence of the inflammation, if a cyst or pocket of pus remains, as a chalazion, it should be removed.

When the swelling of the lid due to acute inflammation has subsided, the chalazion may be felt as a mass in the lid. From the conjunctival side it can be seen as a round, loosely attached body if it is in the lower lid; if in the upper lid, it appears as a discolored streak in the tarsus. A large chalazion may be present beneath the skin of the lid as well as on the conjunctival side. A chalazion should be removed, however, from the conjunctival side. Complete anesthesia can be produced by the hypodermic injection of 15 minims of a 2 per cent solution of procaine. This solution can be had in ampules of convenient size, sterilized and ready for use. The lid should be everted and firmly held in chalazion forceps. The incision should be made along the line followed by the cyst. In the case of deep conjunctival cysts in the culdesac, the incision should be in the direction of the fold, whereas to open a cyst in the tarsal plate of either the upper or lower lid, the incision

should run perpendicular to the margin of the lid. The incision should be long enough to permit free inspection of the inside of the cyst. The walls should be curretted, then swabbed with a caustic agent, such as zinc chloride, silver nitrate, or phenol and alcohol. After further copious irrigation with boric acid solution a bandage should be applied with light pressure to prevent bleeding.

*Ectropion and Entropion.* Ectropion of the lower lid, with hypertrophic conjunctivitis, may often be satisfactorily corrected by cautery puncture, after the method described by Ziegler. Simple excision in hypertrophic conjunctiva is followed by irregular contraction, that shortens the lid between the canthi, and only in exceptional instances should it be done. Surgical procedures for correction of ectropion other than use of the actual cautery, call for more extensive work than should be attempted outside of a well equipped operating room. Entropion of the lid is more frequently brought to the attention because of contracting bands in the culdesac, following chronic conjunctivitis or injury. The normal secretion of the conjunctiva is replaced by a thick mucous discharge which rolls into long strings that sweep about over the eye, causing great annoyance and discomfort. The lashes come in contact with the cornea, producing superficial keratitis which in turn stimulates further congestion and lacerimation.

*Bands and Contractures.* Bands or adhesions varying from only slight contraction in the culdesac to pseudopterygium and symblepharon are of common occurrence. If they result from chronic trachoma, xerophthalmia, pemphigus, or membranous conjunctivitis, the entire conjunctiva may be so changed that repair can be made only through replacement by skin or mucous membrane from some other part of the body. Simple division of conjunctival bands and adhesions is a common office practice that is mentioned only to be condemned. Stretching of bands, or the insertion of plates of wax

or metal after division, only leads to more firm contraction and increases the severity of the symptoms. Contracting sockets following enucleation are sometimes filled with gauze or a large artificial eye in an attempt to enlarge it. The result is always disappointing and increases the difficulties to be overcome in an operation later. The correction of contracted sockets or contracted culdesacs is a procedure that should not be carried out in the office.

*Biopsy.* If properly done, there is little harm at any time in taking tissue from the conjunctiva or lid for biopsy. Probably the greatest error in taking tissue for biopsy lies in taking too little. The pathologist must see the entire lesion if he is to give the most valuable diagnosis. Entire chalazions may be excised without deformity of the lid. Recurrent chalazion should arouse the suspicion that a malignant condition is present and it warrants complete excision of the growth for pathologic examination. The same holds true for recurrent growths about the limbus. A well developed epithelioma of the cornea or conjunctiva, at the limbus, may occur within three weeks from the onset of the first symptom. An effective method for removing limbal growths is through use of the electric cautery. However, the histologic pathology of growths in this region should be known; therefore it is advisable to excise them under local anesthesia before applying the cautery. To remove growths at the limbus, a sharp scalpel should be used. Beginning on the corneal side, the entire growth often can be shaved off and preserved for pathologic study. The denuded area should then be lightly cauterized with an actual cautery and the eye should be closed with a quantity of White's ointment placed under the lid. Any growth worth removing from the eye is worth pathologic examination. Epithelioma at the limbus frequently is not diagnosed; yet it is not infrequently seen. Radium and roentgen rays are of value after the growth has been removed surgically.

#### AFFECTIONS OF THE LACRIMAL APPARATUS

Lacrimation varies with reflex irritation of the eye, and the freedom with which tears can escape through the nasolacrimal duct. Interference with the escape of tears may be brought about by inversion of the lid, so that the puncti rest flatly against the ocular conjunctiva, occluding the canaliculi. With winking of the lids and movement of the globes there is a drawing upward of the secretion from the nasolacrimal duct, through the puncti, because of the valve-like action when the puncti lie flatly against the conjunctiva. Tears will not escape through the canaliculi when the puncti are in this position. Consequently, there is a collection of lacrimal fluid mixed with secretion from the sac, flooding the eye, frequently giving rise to troublesome conjunctivitis. Occasionally, atresia of the puncti also is present. Usually there is less conjunctivitis with atresia of the punctum than is found with a wide punctum that is turned inward against the globe. The difference in irritation can be accounted for by the absence of secretion pumped up from the lacrimal sac. To remedy either condition, it is necessary to establish free drainage for tears through the nasolacrimal duct. After a few drops of cocaine or butyn solution have been instilled, the lacrimal apparatus should be sounded very carefully by a No. 1 or 2 silver Bowman probe. Great care should be taken not to injure the punctum or the lining of the lacrimal sac. If the only obstruction found is in the punctum or canaliculus this may be corrected by simply dilating the punctum a few times, or by slitting the lower canaliculus with an Agnew knife, after the method of Stilling. The necessity for opening the canaliculus is in the minds of most practitioners, very seldom encountered.

The beneficial effect of such operations can be augmented by frequent irrigation of the culdesac and instillation of a mild alkaline lotion, consisting of zinc salicylate, 1 grain to the ounce of saturated solution of

boric acid. A few drops of solution of epinephrine may be added to the collyrium according to the wishes of the surgeon. In more protracted cases, lacrimation and conjunctivitis are the results of occlusion or stenosis of the lower portion of the lacrimal duct. Exploration of the duct with a small sound usually will reveal the situation of the first obstruction below the sac. In infants, it is usually necessary only to push the probe on into the nose to secure adequate drainage. Rapid dilatation of the duct with the use of large probes is successful in some cases, but more often disappointing in its results. The procedure is painful, as it is rather difficult to secure adequate anesthesia by topical applications. If large probes are to be used the procedure should be done under general anesthesia and would better be done in a well equipped operating room. Operations for the relief of dacryostenosis, other than sounding the duct, are hospital procedures. The safety of the eye and comfort of the patient should be the first concern in the treatment of lacrimal stenosis. Many patients who now seek relief for dacryostenosis have had the lacrimal duct probed many times with no benefit. The lining of the nasolacrimal duct is abundant, hanging in folds, and contains many pockets through which a

false opening could easily be made if force were used in exploring for obstruction.

A conservative procedure consists in injecting a few minims of procaine into the lacrimal sac, bringing about analgesia without complete anesthesia. A small probe can then be manipulated in the duct without pain unless undue pressure is used. The patient can then indicate to the surgeon whether the probe is going through the sac, whereupon it should be withdrawn. This procedure may be repeated daily for a week or two. If the duct cannot be opened easily a more radical operation should be adopted. Cellulitis of the face often follows the passage of a probe through the wall of the sac; so great caution should be exercised in probing the duct. Only those who are thoroughly familiar with the use of such probes should undertake to dilate a stenosed duct.

#### GENERAL COMMENT

The practice of office surgery of conditions of the eye should always be conservative. Unless some evident benefit is to be derived from a surgical procedure, one should refrain from attempting operations that cannot be completely carried out under conditions as satisfactory as those which could be obtained in an operating room.



## BLEEDING FROM THE VAGINA \*

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**I**N this age of modern hospital facilities, it would seem as though most cases of bleeding from the vagina should be sent to institutions for treatment. This is true in most urban communities. Nevertheless a considerable proportion of cases receive some form of treatment before arriving at the hospital and this treatment is instituted either at the home of the patient or in the physician's office.

Anyone who has had even a moderate experience on the gynecological services in hospitals in the larger cities, cannot fail to be impressed by the inadequacy of vaginal packing as performed by the casual practitioner. In most instances the tampon consists of a piece of plain bandage gauze about one yard long which is floating about in the vagina and serving no function except as a possible source of infection.

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In cases of incomplete abortion, hydatidiform mole, uterine fibroids or polyps, fibrosis uteri, malignant disease of the uterus (either fundal or cervical), endometrial hyperplasia, and the hemorrhages associated with the latter months of pregnancy, i.e., placenta previa and premature separation of the normally implanted placenta, the hemorrhage may be so alarming as to cause the practitioner to consider immediate packing of the vagina.

At the Long Island College Hospital, we have been trying, for some time past, to impress our students with the fact that in cases of placenta previa and premature separation of the normally implanted placenta, the diagnosis should be made on the history and abdominal findings alone, and that a vaginal examination is not necessary and most certainly not beneficial; and that vaginal packing is contraindicated. We feel that nothing is to be gained by these procedures, and if they are done, they transform a clean case into a potentially infected one. Thus they interfere with the possibility of delivery by cesarean section, if such a procedure is considered.

It is well to keep in mind Cullen's classification of vaginal bleeding when in attendance on a case of this kind: (1) bleeding associated with pregnancy: abortion, ectopic, gestation, hydatidiform mole, retained secundines, chorio-epithelioma, placenta previa, premature separation of the normally implanted placenta; (2) constitutional causes: endocrine dyscrasias, etc.; (3) bleeding *not* associated with the pregnant state: cervical or fundal polyps, endometrial hyperplasias, cervical block, malignant or non-malignant tumors.

If the bleeding is due to causes other than those of placenta previa or premature separation of the placenta, and is severe enough to warrant immediate packing the technic should be as follows:

The patient should be placed in either the genupectoral (knee chest) or Sim's left latero-prone position. The vagina cannot be properly packed with the patient in the dorsal or supine position.

The operator should then encase his hands in sterile rubber gloves (preceded by surgical preparation of the hands if facilities are present).

A sterile Sim's speculum should then be introduced into the vagina. (The Graves bi-valve speculum is of little value in vaginal packing unless it is opened and transformed into a modified Sim's instrument.)

The cervix and vaginal vault is then painted with Tr. iodine or 4 per cent mercurochrome solution applied by means of sterile cotton pledgets about the size of a walnut, held by a sterile sponge stick holder.

Two-inch sterile vaginal packing gauze in the form of a roll should be used. It should be immersed in either normal saline solution or 4 per cent solution of mercurochrome. The gauze must be moist. One end of the roll is grasped by means of a sterile uterine dressing forceps. The roll is held in one hand and unrolled as it is fed into the vagina through the speculum. The first portion of the moistened gauze is placed against the external os of the cervix, then the vaginal fornices are packed. The packing is continued until the vagina is filled to capacity. The amount of gauze used depends on the size of the vagina, but in general it may be said that unless at least 5 yards have been used the packing is inadequate. Some cases take as much as 10 yards.

Vaginal packing should never be left in situ for more than forty-eight hours. Its removal should be gradual, beginning with a few inches at the end of twenty-four hours until it has all been removed.



# VARICOSE VEINS: THEIR CAUSE AND TREATMENT\*

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MANKIND has been afflicted with varicose veins since time immemorial. These afflictions have caused considerable discomfort and inconvenience to some while others have suffered only slightly. Various forms of treatment have been resorted to with numerous good and bad results.

Varicose veins and their relation to varicose ulcers were early referred to by Hippocrates, Galen, Paré, Hunter and Valsalva. Several of these noted men made special studies of the ailment. Hunter and Valsalva were among the first proponents of the theory that stagnation of blood in the veins of the legs was the pathogenic cause of varicose ulcers.

## ETIOLOGY

Among the most frequent causes conceived for the formation of varicose veins are weakened walls as shown by congenital abnormalities or bodily weakness derived through other depleting conditions, infectious emboli associated with a low-grade symptomless phlebitis, endocrine disturbances, stasis due to strenuous strenuous physical occupations, tight garters, etc. Pelvic pressure caused by such factors as pregnancy and tumors is also one of the chief etiological factors. Kashi-mure, a Japanese surgeon, believes that loss of nervimuscular tone is one of the important causes. It is not inconceivable that several of these factors in the same person may account for the varices found among many of our patients.

## PATHOLOGY

The pathology of this aggravating condition has been described by many, of whom McPheeters has given one of the best descriptions. Most of the venous blood of the leg normally flows upward

through two sets of veins, the deep and superficial saphenous. The deep veins are supported by muscle and fascia and seldom have varicosities. The superficial veins have little support except their thin walls and the overlying skin. Both have valves supporting their respective columns of blood.

Due to the causes already enumerated the weakened walls of the veins give way. The valves, unable to support the extra column of blood, allow a backflow. Dilatation, distention, sacculation and elongation are the results. They have been classified into four different sizes: (1) up to 0.5 cm.; (2) 0.5 cm. to 1 cm.; (3) 1 cm. to 1.5 cm., and (4) 1.5 cm. to 2 or more cm. Those larger than 2 cm. in diameter are generally saccular and aneurysmal in type.

Much discussion has been carried on regarding the direction of the flow of blood in cases of varicose veins. It has been shown under the fluoroscope that when 1 c.c. of lipiodol was injected near the outlet of the long saphenous vein it was forced by muscular pressure to below the knee, thence through the communicating veins to the deep saphenous vein. Muscular action of the toes and ankle caused a fluctuation in the deep saphenous vein while by pushing the toes against a solid object the blood would flow upward into the iliac veins. None flowed upward through the superficial saphenous vein. This shows therefore that the flow of blood in varicose veins of the leg is practically stationary or reversed, flowing from the superficial to the deep through the communicating veins.

## SYMPTOMS

The symptoms of this unpleasant condition, such as early fatigue in walking or standing, cramps in the legs, severe pain where there is a phlebitis or periphlebitis,

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depends upon the degree of incompetency of the veins. If ulcers are present serious hemorrhages may take place.



FIG. 1. Legs of patient before injection. Left leg (No. 2) shows dilated vein beginning at edge of ulcer and extending nearly to knee. Leg No. 1 was very similar to left.

#### DIAGNOSIS

The degree of varicose involvement must be determined by a very careful examination. Not only must the circulation of the extremity be accurately determined but the patient's general condition, especially in relation to his circulation and kidney function, requires a careful study. Cardiac decompensation with hypertension needs careful checking up, also cases with acute or chronic nephritis and diabetes. The main fact to be determined relating to the circulation of the extremity is the patency of the communicating and deep veins. Pratt's method is probably one of the best and most recent tests. He applies an ace bandage around the leg below the

saphenous opening sufficiently tight to prevent circulation in the superficial veins. If after walking 10 blocks there is no pain in the leg the deep veins are considered to be functioning normally. Phlebitis and periphlebitis must be ruled out as tested by looking for painful areas on pressure and pain experienced by the patient on walking.

#### TREATMENT

Having ruled out such complications as have been mentioned one can then proceed with the treatment. The history of the injection treatment dates back to the invention of the hypodermic syringe by Pravaz in 1851. Attempts were made to obliterate the veins by perivenous and intravenous injections. Alcohol, phenol, ergotin and other chemicals were used but were soon discontinued because of the disastrous results from infections, hemorrhages and emboli. Linser and Zirn (1916) noticed the hardening results to veins from the intravenous use of bichloride of mercury in treating lues. Frequent cases of mercurial poisoning resulted but stimulated research for a non-toxic solution that would cause a permanent thrombus. To this end they found that 20 per cent sodium chloride was a good substitute for mercury in obliterating veins. Sicard and Forestier noticed during the war that alkaline solutions produced hardening of the veins. They used sodium carbonate but this was too caustic and they were obliged to discontinue its use. Later they used sodium salicylate with much more satisfaction, but found that in an occasional case it caused severe toxic symptoms. Noble of Germany is a strong advocate of invert sugar solution while in England quinine and urethane preparations are popular. McPheeters has used sodium salicylate, sodium chloride and sugar solutions with excellent results. Sodium salicylate is an excellent drug but an injection of a small amount, 1 to 2 c.c., is necessary to test out the liability of its specific toxicity to the patient.

Considerable discussion has been in

vogue of late as to the advantages of the injection treatment over the surgical removal of the defective veins. It would

of a thrombus. Statistics show that this is more theoretical than real, only 4 authoritative cases thus far having been

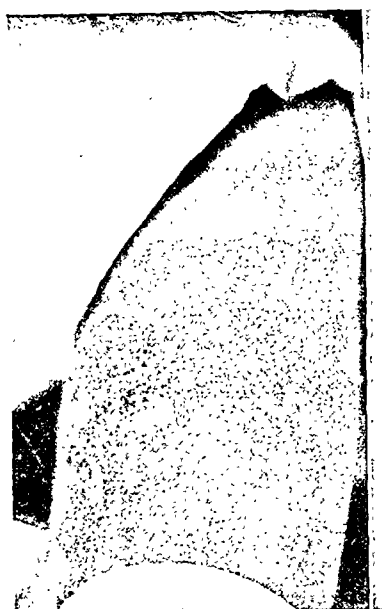


FIG. 2.



FIG. 3.



FIG. 4.

FIG. 2. Part of right leg with eczematous area under which was large dilated saccular type of varicose vein.

FIG. 3. Needle inserted in vein with syringe containing injecting solution.

FIG. 4. Empty syringe after injection. Above point of injection is a rubber tourniquet tied lightly around leg. This is immediately released following injection.

seem, according to the recent literature, that the injection treatment, causing a definite injury to the venous walls, a permanent thrombosis and final obliteration of the veins, is the method of choice. Statistics show that the risk from surgical removal is 1 in 250 while with the injection treatment it is 1 in 5000. The objections to operative risk are:

1. The more frequent occurrence of fatal emboli.
2. Recurrence of varices in the communicating veins sometimes extending across the area of removal to the communicating vein on the opposite side.
3. Unsightly scars.
4. Confinement of the patient from three to six weeks, a very important economical factor.
5. The danger from postoperative infections.

The chief objection to the injection treatment is the theoretical formation of an embolism secondary to the formation

reported in the literature. McPheeters reports a case of a patient suddenly dropping dead ten days after an injection treatment. Autopsy showed a recent thrombus in the orifice of the pulmonary artery. Examination of the injected veins showed well-formed thrombi.

#### REPORT OF CASES

I wish to report results of the injection treatment on 20 cases. Five cases had an involvement of both legs. Three cases were males, the remaining women. Two women were under thirty-five, the remaining patients between forty and sixty years of age. Trendelenburg tests were made before injections were begun. One complication resulted. Some of the solution (sodium salicylate in this case) leaked out through the puncture opening of the thin veined walls in a man aged sixty. A small slough resulted, taking two months to heal, but the results to the vein were excellent. All the other patients were

cured of their varicose veins with no recurrences. Several had swollen and tender legs for about two weeks after treatment due to the chemical phlebitis produced by the injections. According to the many workers this counts for a favorable result. The solutions used were sodium chloride 20 per cent for 8 patients and sodium salicylate 40 per cent for 12 patients. A Luer syringe with 26 gauge needle was used. The amount injected was a variable factor, depending upon the size of the vein. The injections of sodium chloride varies from 3 to 8 c.c. per vein while those made with sodium salicylate ran from 2 to 5 c.c. One leg at a time was usually injected, with a tourniquet above the beginning of the varicosity. All patients were treated in sitting posture. All patients complained of a stinging pain lasting five to ten minutes in the leg at and below the point of injection. The sodium salicylate produced a more severe pain than the sodium chloride. All patients were allowed to be upon their feet daily.

#### COURSE

Immediately after injection the vein becomes hardened and the tortuosity changes into a straighter line. After a few hours the skin over the injected area takes on a bluish or copper color which lasts for several days. Patients should be warned against bumping their legs during the time the organization is going on. It tends to cause injury to the thrombosed vein wall, pain in the injured leg and prolongs recovery. Swelling of the leg is apt to occur, due to the phlebitis of the communicating as well as the injected veins and lasts two to three weeks. Occasionally some of the injected solution will leak out of the thin punctured venous wall, resulting in a slight infiltration of the surrounding tissues, or the solution may be injected

outside of the vein. Both of these procedures cause a slough painful and slow in healing. They are best treated by further infiltration of the area with normal saline solution, reducing the concentration of the previously injected solution. Two months are often required for sloughs to heal.

Several investigators, both American and European, have reported upon the histological changes in veins. All agree that the chemicals injected injure the intima, allowing an infiltration into the venous wall. Fibrous tissue develops from the proliferating connective tissue of the venous walls, red and white blood cells are deposited and a firm thrombus results. Organization takes place during the next few weeks and a fibrous cord is the result, thus giving relief from symptoms and a better looking leg to the patient.

#### SUMMARY AND CONCLUSION

1. A careful physical examination is necessary before any treatment is commenced for varicose veins.
2. Patency of the deep veins must be definitely established.
3. Phlebitis and cardiac defects, nephritis and diabetes are contraindications to either surgical or injection treatment of varicose veins.
4. Any treatment must aim to obliterate the superficial vein and utilize the deep vein for the functioning one.
5. Surgical operations have been less successful than the injection treatment. They often result in recurrences, sloughing, infections and bad looking scars, and prevent the patient from working from three to six weeks.
6. The injection treatment for varicose veins seldom interferes with the occupation of the patient and gives the best permanent result.

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## INFECTION OF HAND & FINGERS\*

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CONSIDERING the fact that the hand comes in contact with contaminated objects more than any other part of the body, and that the fingers are exposed to more injuries than any other organ, it is remarkable that infections of the hand and fingers are not more common than they really are. They belong, nevertheless, to the most frequent pathological conditions the general practitioner is called upon to treat.

### PATHOLOGY

Infections of hand and fingers are due to the entrance of microorganisms through wounds, among which the punctured wounds play the most important rôle. And here again it is the volar surface of the hand and fingers which is more apt to be infected and where infection is of greater danger, owing to the predisposing histological structure of the skin of this surface. When a sharp instrument or sharp body makes a puncture on the soft part of the skin of the dorsum an ensuing infection

will meet a pliable skin yielding readily to the formation of an abscess. But when the inner surface of the fingers or hand is punctured and infected, the skin, being of a tougher character and the underlying fat of coarser structure, does not yield and hence the infection penetrates into the deep tissues. This endangers the vitality of the deeper structures and leads to all kinds of complications. It is important, therefore, that punctured wounds and small cuts of the volar surface always be regarded with suspicion, and treated with a presumption that they are apt to be infected more than those of other parts of the hand. Another peculiarity of infections of hand and fingers, again referable to an anatomical peculiarity, is that the wound infections of the dorsal surface are apt to lead to rapid propagation through the lymph channels in the form of lymphangitis, while the infections of the volar surface are more apt to be localized and restricted to the phalanges as so-called felons, or to the palm as abscesses within

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the tendon sheaths, intercommunicating with joints or other structures. The infecting microorganisms are either streptococci, staphylococci or other pus-forming microorganisms which enter the tissues of the fingers or hand through punctured wounds with or without a foreign body, such as a small sliver, splinter, a piece of cloth, or other material.

#### SYMPTOMS

The symptoms of infection may be clear and manifest or they may be very obscure and misleading. As a rule the focal symptoms predominate and lead the physician to an early diagnosis. The local signs of inflammation: heat, swelling, tenderness, redness, as well as a throbbing of the part, will make an early diagnosis of acute infection very probable. The general symptoms are those common to all other infections, namely chills, fever, general malaise, headaches, rapid pulse, etc. However if the infection has lasted for some time these acute symptoms may subside or may become very insignificant. The acute infection usually turns into a sub-acute one and may lead to a chronic infection, which is characterized by a different symptomatology, namely: the formation of exudate and localized death of tissues or necrosis. The exudate is as a rule purulent. The tissue underneath the tough skin is melting away into a debris consisting of pus and blood, and structures like tendon and bone which have only a meager circulation easily die off, becoming entirely deprived of nutrition because of the thrombosis of the blood vessels and the pressure of the exudate. These abscesses follow predisposing channels along the sides of the tendon sheaths and in many instances lead to their necrosis. This is a very important complication as it has its effect upon the function and the use of the hand. Once established, such an abscess of the tendon sheath is apt to push forward into the palm of the hand, destroying the tendon and perforating into the loose tissue of the dorsal surface, thus

circulating the pus into important structures of the hand and leading to destruction of various kinds with contracture or stiffness as common sequelae.

The symptoms of abscess are in many instances characteristic. Fluctuation shows the presence of liquid exudates. Edema is strongly indicative of deep suppuration. Besides the tendon, the bones are very often exposed to the effect of pus. The periosteum is one of the structures which are easily infected through propagation of the process, and a subperiosteal abscess lifts the periosteum from the bone, depriving the bone of its nutrition. This results in an osteitis and osteomyelitis followed by partial or total necrosis of the bone (sequestrum formation).

One of the most dangerous complications is that of infection reaching the capsule of the phalangeal joints and the joints themselves. While we are capable of dealing favorably with the other complications, this one inevitably destroys the function of the joints by leading to a necrosis of the cartilage, which is very poorly nourished by the surrounding blood supply. Fortunately the capsules of the larger joints are very resistant to the acute infection, and as a rule only the small joints suffer in this manner.

#### DIAGNOSIS

The diagnosis is made from the symptoms already mentioned. The x-ray is a very valuable asset in clinching the diagnosis of infections. While inflamed structures do not show any special shadows, the inflammations change the structures of the bone to such an extent that the trained eye of the roentgenologist easily detects the presence of osteomyelitis, osteitis and periostitis. The shadows and the structure of normal bone disappear and the irregular, transparent shadows of the diseased bone take their place. The sequestrum becomes visible. One of the most characteristic symptoms of this infection is the appearance of pus, which by breaking down the tissues forms a

fistula from which it escapes. As soon as this stage is reached, either spontaneously or through the interference of the doctor cutting into the abscess, the general symptoms usually disappear and the acute infection turns into the subacute, chronic stage.

#### COURSE AND RESULTS

There are hundreds of possibilities following infections of the hand, many depending upon their management and treatment. General sepsis and fatalities are rare. Spontaneously and unaided by the physician many infections yield excellent results, even if treated only by home remedies such as poultices. The infection leads to an abscess, which ripens and breaks through, emptying the pus, and then heals up without leaving a trace behind except a tiny scar. There are other instances in which treatment begins too late. Complications will have arisen, but prompt action can still save the appearance and function of the fingers or hand. There are others which are faultily treated and become so extensive that when they come under the care of the reliable physician irreparable destruction has taken place and function and shape may suffer greatly. Contractures or stiffness of the joints may result from these infections so that the grasp, the hand's most important function, is impossible. Besides the acute, subacute and chronic septic infections there are other infections by different microbes, as the syphilitic and tubercular, which have a protracted chronic course. They require special consideration.

Among the local infections of the fingers and hand are some of trivial nature, starting from hangnails and small injuries on the side of the nails, the so-called run-arounds or paronychia, which lead to very superficial abscesses and are easily dealt with.

#### TREATMENT

The treatment of the infection in the hands of the expert surgeon is standardized

and agreed upon. But the treatment by the general practitioner in his office needs some discussion. First of all, every infection of the fingers should be looked upon as a serious matter, because of its possibilities and complications. The consideration that the infection may disappear without any interference and heal spontaneously should never be accepted too lightly. Most of the septic infections lead to abscess formation. It is, therefore, the object of the physician to watch this abscess formation to stem its tide, and localize it if possible. This can often be done by using the passive hyperemia method of Bier on the infected finger. This consists of shutting off the circulation of the finger by the circular constriction of a rubber band used as a tourniquet. I do not believe that many formations of abscess have been prevented, but fortunately we have seen cases threatened with rapid propagation, which were limited to one or two phalanges, or to a felon, by such a rubber band. Heat and moist dressings are the most advantageous remedies, also hot baths and alcohol applications. Heat brings more blood to the infected area and accelerates the formation of abscess. Whether we apply a hot bath, poultice or electric pad is immaterial. Moist dressing with acetate of lead in the form of so-called Billroth solution, boric acid applications, or the thermic lamps are very beneficial. The crucial part of the treatment is the question whether surgical interference is necessary or not, and herein most of the mistakes are made. Sometimes very aggressive activity in the first place is harmful. It is best to decide first when to incise, second, where to incise, and third, how much to incise. As to the first question, when to incise: Many make the mistake of incising too early and therefore unsuccessfully, because the pus formation has not yet reached the stage of a melting process. Fluctuation, the characteristic sign of abscess in a finger, is difficult to diagnose. The second question, where to incise: There are certain rules about this.



It is best to incise in the direction of the blood vessels, not too close to the tendons or joints, yet into the abscess. The last question, how much to incise: Here the practitioner sins most. If he is of an aggressive nature he is liable to incise too much, but many practitioners are too timid and their incisions reach only the superficial surface, not the abscess, and therefore are useless. The incision, however, is not the only thing the practitioner has to think of. He has to establish a successful drainage, and that is best established in many instances by connecting two incisions through an underground channel which is kept open by silk thread, catgut, or tube or gauze.

An important consideration is the after-treatment of such incisions. Moist warm dressings should be continued, irrigations and local baths, with or without additional antiseptics. These depend upon individual taste more than upon absolute indication and have changed from time to time according to the vogue and, perhaps, mostly because of the advertising by commercial interests.

This treatment of incision of abscess

can be done in rare instances with a local anesthetic, but in most cases the patient because of sleeplessness and pain for days is in an excitable condition and is better off when put to sleep for a few minutes. Local anesthesia by freezing is only applicable for very small incisions. Hypodermic injections are very painful so that a few sniffs of gas are most convenient. The after-treatment of a case of chronic suppuration becomes an office routine, as it is often of long duration or the result of a radical and extensive operation in the hospital and the patient does not require hospital care. The after-treatment of cases of chronic infection, after they have healed, in order to improve the function should not be neglected. The office treatment does not terminate when the suppurative process has stopped, but should be continued in the form of massage, electric pads, local baths, and active and passive motion until the function of the hand is restored to the best efficiency possible. Many fingers and hands have been surgically cured, but have remained stiff and useless because of neglect of the all-important after-treatment.



## PRACTICAL POINTS IN THE MANAGEMENT OF GONORRHEA IN WOMEN\*

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GONORRHEA is so common that it should interest every one of us. Just how common no one knows, but amazing statistics might be quoted. We have all seen figures which show that 80 per cent of our population have at some time or other been infected, and that 90 per cent of these have not been cured. It is the commonest cause of sterility, yet it must cause sterility comparatively infrequently, else, with so many not cured, we should not

have to discuss birth control at all. Perhaps the figures are extravagant, but in all probability they are not. Even hasty consideration of its possibilities should convince us of that. One of the most destructive diseases, it is responsible for more sickness and disability than tuberculosis or any other disease we encounter.

Every day, in its chronic forms at least, it is seen by every physician. To the gynecologist it is omnipresent. So common, that he sees it everywhere and has but to

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guard against its too ready recognition, or diagnosis by suspicion.

The general practitioner must meet the same situation, for on him depends the initial treatment and the all-important duty of informing the patient of the sequelae due to neglect; he must tell her that the cure is necessarily slow, but not at all impossible, and that vanishing symptoms do not always mean disappearance of the lesions.

Its practical diagnosis must not rest upon positive smears. They are too hard to get. All too often they are negative, even in the acute stage. If the smear is positive, so much the easier, but it is well to remember that negative spreads are almost the rule, and that positive results are obtained only after repeated trials or provocative treatment, and often not even then. Any conception of the disease which does not take this into consideration makes recognition hopeless and treatment futile.

With this in mind, how can we recognize it? How is the practical diagnosis made? Certainly not by the smears, but by careful appraisal of the history, and systematic pelvic examination. I am speaking in general terms of course, but what I have to say applies to the vast majority of cases.

First, the history. If the patient says that she never had a discharge until marriage, that is probably gonorrhea. If it has been very profuse from the start, it is certainly so. If the discharge followed parturition, it may be due to laceration and infection of the cervix but the underlying etiological factor is often gonorrhea anyway. Treatment of the cervix will be signally unsatisfactory if this is overlooked.

The importance of urinary symptoms such as burning, urgency, frequency and tenesmus cannot be overestimated. Careful questioning may be necessary to bring out the fact that at some time since marriage or coitus, these symptoms were present, even for a short time.

The menstrual history is valuable, and almost any change that followed marriage is significant. Marriage means pregnancy

or infection, often both. Sometimes we see a gradually lengthening period, from three or four to six or seven days or more, an increasing menorrhagia. Sometimes the menstrual interval is shortened, and menses recur every three weeks, or twice a month, or some other variation of the cycle. Less often periods are delayed, usually with a lessened menstrual amount, gradually approaching amenorrhea. Almost anything is possible depending upon the site and extent of the pelvic lesion. The important consideration is the association of the menstrual disturbance with marriage.

Pain is not a constant factor, but is usually premenstrual and comenstrual, relieved by the flow itself. With dyspareunia and painful defecation, however, pain occurs so often in other conditions that it is corroborative only, and helpful, but not of great diagnostic importance.

Pelvic examination should be preceded in all cases by careful inspection of the vulva, under good light. A head mirror is valuable. In acute cases the intense inflammation of the vulva and the profuse discharge is so characteristic and significant, that diagnosis has to be made but from the acute recurrences which we see so often. There is nothing else like it.

It is with the subacute or chronic case then, that we are most concerned. Look first at the urinary meatus; it rarely escapes. The mucosal redness, edema and pouting of the acute stage have disappeared, but unmistakable evidence always remains. The orifices of the urethral glands are large and red, and the mucosa has lost its uniformly pale color. The urethra is large, thick and sensitive to the finger which strips it carefully in the search for pus, which is of great importance in the diagnosis. As a rule pus can not be expressed until the index finger, following the course of the urethra around the symphysis, presses upon Skene's glands. Thick creamy pus can be nothing else but gonorrhea. Discharge not frankly purulent, thin, small in amount, and apparently from the urethral glands is highly suspicious,

and more often than not, evidence of gonorrhea too. In children it is particularly important to consider all vulvovaginitis as gonorrheal in origin.

Look at the orifices of Bartholin's glands too. They may be seen as two small red points near the last caruncle; the macula gonorrhoeica is diagnostic. The glands themselves may be palpated in the lower part of the labia majora; when they are felt, they are important aides to diagnosis.

The cervix is often atypical and our impression of it may depend upon the stigmata of gonorrhea which we have already seen in the vulva. Endocervicitis in the nullipara is almost always Neisserian in origin. A red cervix with yellow pinhead spots irregularly distributed about a cervical os which is pouring pus or plugged with thick glairy mucus is very characteristic.

Salpingitis is usually salpingo-sophorometritis. It is difficult to conceive of an isolated inflammation of the tubes, and proper appreciation of the point will give us a better idea of the pathology within the abdomen. Palpation of adnexal masses is, of course, not essential in the diagnosis, for flaming tubes with open ends may not be felt at all. The diagnosis is made upon the history, signs in the external genitalia, menstrual disturbance, and often the physical signs of the associated acute or chronic peritonitis.

Treatment should be faithful, painstaking, continuous, and carried out with great attention to detail. It is not in any sense difficult, nor is special training required. Acute cases rarely need local treatment. The speculum and douche are harmful. Copious bland irrigations of the vulva, posture drainage, gentle laxatives and urinary antiseptics are all that the patient needs. Time will bring with it more or less immunity, and general localization of the infection will take place. In its subacute and chronic stages it must be sought out and attacked in the places where we expect to find it. Intra-abdominal complications can best be avoided by

expectant treatment, but it is well to remember that they often occur two or three months after the vaginal infection, whether local treatment has been carried out or not.

Coitus should of course be prohibited. That goes without saying. It is particularly important, however, to observe this rule when dealing with the chronic cases, where the diagnosis, perhaps tentative at first, has been established to our own satisfaction.

The arrangement of the urethral and cervical glands is such that we cannot expect very encouraging results from antiseptics applied to the surface epithelium of the urethral and cervical canals. Fortunately, however, the urethritis is soon confined to a point just within the meatus. With hairpin retractors, the gland orifices are seen, and injected with 5 or 10 per cent nitrate of silver through a blunt short hypodermic needle. Under local anesthesia, the glands may be slit with a cataract knife, or still better, destroyed by a fine tip actual cautery carefully inserted into the lumen while cold, and then heated cherry red. This may have to be repeatedly done, and often preceded by a dilating cold sound which will relieve the not infrequent stricture, and cause an acute urethritis which rapidly subsides. Injections of organic silver preparations are soothing but not consistently bactericidal. Other aqueous solutions are disappointing, but their efficiency is increased by the addition of small amounts of boroglycerine. Injections of the same into Bartholin's glands with a blunt needle are occasionally successful, but generalized infection necessitates resection of the entire gland.

Vulvovaginitis in adults is not a serious problem, as mature squamous epithelium is very resistant to the gonococcus. In children, this condition is best treated by the method of Norris, who depends upon cleanliness of all the parts, careful drying, and general development of the immature epithelium by the use of weak

solutions of nitrate of silver. Treatment is carried out in Sim's or knee-chest position.

Acute endocervicitis should never be treated. It invariably lapses into the chronic form, and, though difficult to treat then, pelvic complications are not so likely to follow. There is no specific treatment. Organic silver salts are useless. Nitrate of silver in 5 to 20 per cent solution is probably our best agent, but it should be cautiously applied to the cervical canal. Large quantities of kaolin applied to the vaginal vault and held in place by a tight dry tampon will be found helpful. Gellhorn's injections of methylene blue 1 per cent, sterile normal saline are very valuable. Though a short hypodermic needle, 1 c.c. is injected into the cervical tissue at three or four points 0.5 cm. from the cervical canal and parallel to it. Packing the cervical canal and vaginal

vault with narrow strip gauze, saturated with 5 to 10 per cent mercurochrome in 50 per cent alcohol will often give good results. Puncture of cysts and striping the cervix with the nasal tip cautery is the latest cure to find favor. It should be cautiously done and not too often. A volume could be written on the treatment of this most intractable lesion, but enough has been said to indicate that intelligent persistent treatment carried out for a long period of time is essential.

Extirpation of adnexal lesions in young women is indefensible. The organism disappears here, long before it can be eradicated elsewhere. Pitiful end results are common. When we come to realize that pelvic exacerbations are nothing more than re-infections, we will more than ever concentrate our attention upon stamping out the disease in the external genitalia and the cervix.



## WEBBED FINGERS\*

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**W**EBBED fingers is a condition in which two or more digits are united by their lateral aspects. They are as a rule congenital but may be acquired, as subsequent to a burn or other injury which destroys the epithelium of the contiguous surfaces of two digits. Contrary to the experience of some authors, the thin web or *main palmé* has occurred in the authors' experience with equal frequency to the fused fingers or real syndactylism. The following method of corrective treatment has been found most adaptable to webbed fingers, that is with regard to the thickness and narrowness of the web.

The procedure is as follows:

The local area is prepared as for surgery and asepsis is employed throughout. Local

anesthesia with 0.5 to 1 per cent procaine, except in infants when an anesthetic is unnecessary, is obtained. A clamp, sufficiently crushing to kill the clamped tissues, is then put on the center of the web. Any type of clamp, varying from the Shoemaker intestinal anastomatic clamp to the ordinary Halsted "mosquito," serves the purpose most satisfactorily. The clamp is held in place by proper bandaging and the fingers immobilized in splints for a period of eight to fourteen days. The crushed tissue becomes a non-vital, dry membrane by four days. It is, however, unwise to move the clamp too soon or to cut the crushed tissue, for the healing is insufficient to hold the skin edges intact until approximately ten days have elapsed. Certainly this is true in the narrow web

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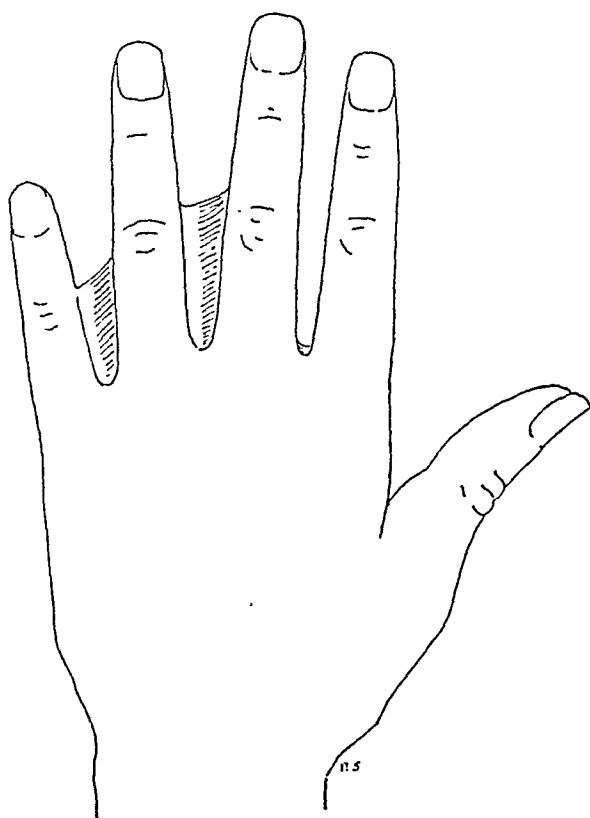


FIG. 1. Webbed fingers of boy, aged ten.

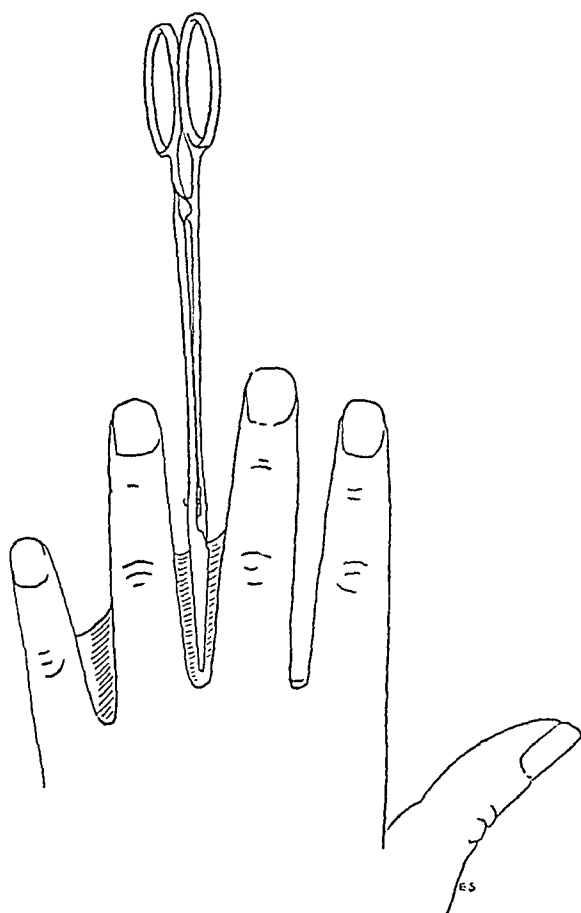


FIG. 2. Crushing clamp applied.

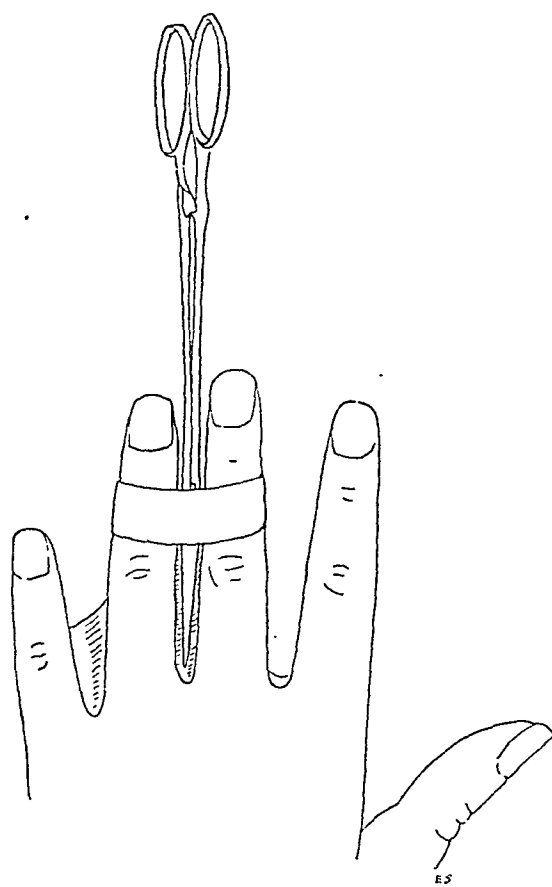


FIG. 3. Crushing clamp held in place ready for bandage and splints.

of 3 to 4 mm. thickness and, therefore, in this type immobilization for a total of fourteen days is advised.

This pressure necrosis method is possible since the digital arteries, veins and nerves lie close to the phalanges.

Following the usual teaching, the correction of a web on one side of a finger is completed before the web on the opposite

side attacked. The method would seem equally as applicable to webbed toes although, as yet, it has not been attempted. The method has been used up to the age of ten years, but it is best employed in infancy.

The results have been most satisfactory both from a cosmetic as well as a functional standpoint.



## CERVICAL LACERATIONS AND INFECTIONS\*

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**B**EFORE taking up the office treatment of these conditions, let us have a clear idea of the pathological processes to which the cervix is prone and try to evaluate the measures necessary for their correction. The most important are congestion, infection, laceration and malignant change.

It is of the first three that we are concerned as far as the possibility of office treatment having any helpful effect. Many a case of simple chronic passive congestion has been called chronic endocervicitis. The dictum that every lacerated cervix is infected does not stand the test of careful clinical investigation. True, a great many are, and in many cases it is at times extremely difficult to differentiate between infection and congestion and as congestion renders any structure more susceptible to infection, the picture is more complicated.

A careful history and thorough physical examination will often reveal that although there is leucorrheal discharge and the cervix is lacerated, enlarged, everted and eroded, the cervix is more sinned against than sinning, the condition in the cervix being the effect of other lesions as well as of the lacerations. The commonest condition is subinvolution. For many years we have used the term subinvolution of the

uterus, whereas in reality the condition is one of subinvolution of the entire pelvic contents, and the underlying lesion a subinvolution of the uterine supports. If one will carefully determine in such a case the excursion of the uterus, one is often surprised to find that he can push the uterus up into the plane of the brim or down into the introitus; that he may hold it tight against the pubis or push it back into the hollow of the sacrum.

The question naturally arises, where is this uterus when the woman is on her feet? The old examination of a woman in a standing position had much merit and often would reveal conditions unthought of if the examination was carried out in the usual manner. Before such a woman in the child-bearing period is subjected to any operative procedure on the cervix, even though there may be some degree of laceration, she should be treated with the idea of stimulating involution of the uterine supports and of the uterus as a whole.

Again, careful examination will reveal the fact that many of these women are of the ptotic type with poor general muscular tone, faulty posture, flat feet, varicose veins, etc.

Before such a woman's cervix is con-

\* From The Department of Obstetrics and Gynecology, Long Island College Hospital. Submitted for publication December 18, 1929.

demned to surgery, much can be accomplished to improve her general condition and to stimulate involution. Tonics, proper

there is infection, examination will often reveal a slight amount of tenderness in the pelvis, generally in the parametrium



FIG. 1. Section through portio of cervix.

- A, Squamous epithelium of cervix.
- B, Healing follicular erosion being lined by columnar epithelium.
- C, Hypertrophy and hyperplasia of cervical glands.
- D, Druse exudate in stroma and about the glands, consisting of small lymphocytes and plasma cells.



FIG. 2. Section through center of same excised cervical cone.

- A, No exudate about glands or in fibromuscular coat of cervix.
- B, Absence of hyperplasia and hypertrophy of muscle cells.
- C, Gland spaces are normal.

food, proper rest, attention to the bowels and bladder, tampons, douches, knee-chest posture, and that most valuable instrument, the pessary, will all have a definite place. If there be much erosion, painting with 20 per cent silver nitrate or brushing with the electric cautery will invariably cause complete healing, and if there be extension laceration with considerable eversion, a very deep linear cauterization with a thin blade will often give astonishing results. All of this, of course, takes time and the condition should be carefully explained to the patient lest she become impatient and fail to cooperate.

#### CHRONIC ENDOCERVICITIS

As said before, at times it may be exceedingly difficult to differentiate between the cervix which is simply congested and the one which is infected. Where

and uterine sacral ligaments caused by a pelvic lymphangitis analogous to the lymphangitis which accompanies infection elsewhere. The cervix may be enlarged, eroded and infected and bathed with a mucopurulent discharge. In long-standing cases, the cervix is cystic and hard with hyperplasia.

Histologic examination of the cervixes which have been removed will show the marked, round-cell infiltration characteristic of subacute inflammation and also show in the majority of cases that the infection only extends from 1 to 2 cm. up the cervical canal. (Figs. 1 and 2.)

Novak pointed out in a recent paper that in the first stage of endocervicitis there is a hypersecretion of the cylindrical epithelium and an extension outward on the pars vaginalis with production of an erosion. In this stage, the erosion is covered with cylindrical epithelium. The latter

still retains its gland-forming tendency so that many gland invaginations may be formed far out on the pars vaginalis. As the inflammation recedes, the squamous epithelium asserts itself again, pushing back the cylindrical epithelium to the region of the external os.

The treatment is obviously the destruction or removal of this infected cylindrical epithelium. This can be accomplished by three methods: operation, caustics or the cautery. The disadvantage of the operation is well known. All surgeons can recall patients who are sterile, who have had abortions or who have had cervical dystocia following operation in the child-bearing period. With this in mind, we believe that other methods should be faithfully tried before operation is advised.

That these cases can be cured by means of the cautery is born out by numerous articles in the literature reporting large series of cases by many observers. It is not our purpose to discuss any series of cases, but rather to describe the method.

We have found that the best results are obtained by using the nasal cautery loop and blade. The transformer should be a noiseless one which can be obtained from any instrument house. The handle should have a finger switch which gives perfect control of the current. Only enough current should be used to give a bright, cherry-red glow to the blade or loop.

The most important factor in the procedure is the management of the patient. She should be told just exactly what one expects to do, that she will experience a fleeting sense of heat and that as soon as she feels it, she is to say so and the current will be turned off. She should be told that this treatment cannot be carried out in one sitting, but that several will be necessary. The necessity for patience and cooperation must be explained.

The cervix is then exposed, any discharge removed and the cold blade laid on the area in the periphery of the erosion one wishes to cauterize first. The current is then turned on and as soon as the patient

feels it the current is turned off. She is then asked, "How much did that really hurt?" and she will generally reply, "Why, not much." "Could you stand another application like that now, or would you rather wait until the next treatment?" Most women will stand from three to six applications the first visit. Others who are high strung and nervous had better be given only one so that their confidence can be obtained. The patient is told that she will have an increased discharge for a few days and that there may be a little bleeding which is unimportant; that she should take a daily alkaline douche and return in one week.

At the next visit it will be found that there is a slough at the site of the cauterization. This may be wiped off and the raw surface touched with an applicator dipped in 10 per cent silver nitrate solution. At this time, several other areas may be cauterized, depending on the tolerance of the patient. After two or three treatments, it will be found that all exposed cervical mucosa and erosion have been destroyed and that squamous epithelium of the portio is covering the area. When this has been done, the lower part of the canal may be cauterized. This should be done with the greatest care for if the cauterization is too deep, distressing stenosis or atresia may occur. Generally four applications at one sitting will be all that is necessary. Douches are continued and the patient returns once a week for cleansing of the slough and stimulation of the squamous epithelium with weak silver nitrate solution. In from two to three weeks following the last cauterization, the cervix will be healed. The time varies, however, a great deal depending on the severity of the lesion and the ability of the patient to tolerate the treatment.

If cysts are present near the surface, they may be punctured with the cautery loop. When there is much eversion, a few deeper linear cauterizations may be made, care being taken not to invade the canal lest one cause stenosis or atresia.



## LACERATIONS OF THE CERVIX

We are perhaps too prone to think of lacerations of the cervix as just lacerations, forgetting that the trouble does not lie in the laceration *per se*, but in the changes which may take place because of the laceration. Many a woman has a lacerated cervix, at times quite extensive, who complains of no symptoms and it is only when some subinvolution or infection superimposes that she complains. That a laceration tends to cause sterility is not true. It is only when there is subinvolution with marked passive congestion and increased hypersecretion or infection with again hypersecretion, the latter of the mucopurulent discharge, that spermatozoa cannot pass. Measures to remove congestion and to stimulate involution with cauterization of the infected mucosa in infected cases will be all that is necessary.

The only lacerations which require operation in the child-bearing period are the very extensive ones and here trachelorraphy should be the operation of choice.

When the lips of the lacerated cervix are everted with exposure of the cylindrical epithelium, removal of this exposed epithelium and its replacement by squamous epithelium leaves simply a misshapen portia with a shortened canal lined by healthy cylindrical epithelium. Such a cervix does not predispose to sterility nor will it cause dystocia as there is no scar tissue in the body of the cervix.

Emmett, many years ago, pointed out the danger of scar tissue and so was careful to remove it, and did his careful trachelorraphy hoping for and obtaining primary union without scar tissue formation.

While this paper was being prepared, I saw a young gynecologist do a tracheloplasty on a perfectly good inoffensive cervix with a very mild degree of infection with moderate erosion; one in which a very short period of cautery treatment properly carried out would have been all that was necessary.

So perhaps after all the topic is not untimely.



## DEFECTS OF THE TOE NAILS

(INGROWN AND VERTICAL)\*

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THE literature on this subject seems rather meager when we consider the frequency with which we see both ingrown toe nails and the vertical nails.

"Ingrown" toe nails is a misnomer, since the nail is really *overgrown* by the soft parts. Failure to trim the toe nails squarely across the end, which would allow the distal corners of the nails to over-ride the soft parts, is responsible for much of this condition. Narrow toed shoes, low hard toe caps, socks too long or too

short, are also blamed in most articles on the subject. The nail, however, is only a passive offender, and when properly trimmed straight across, leaving the corners square, and not too short, it is practically impossible for the condition to occur.

Vertical toe nails are usually a result of incorrect fit of shoes (too short), in which the crowding of the soft parts of the toe into the end of the shoe results in pushing up the flexible nail. The matrix becomes hypertrophied, and a thicker nail is formed.

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In cases of ingrown toe nails of long standing, exudate forms in the nail sulcus as a result of the combination of infection

corner of the nail, or a thin strip of gutta percha, often act as a traumatizing factor if worn for any length of time, but do give

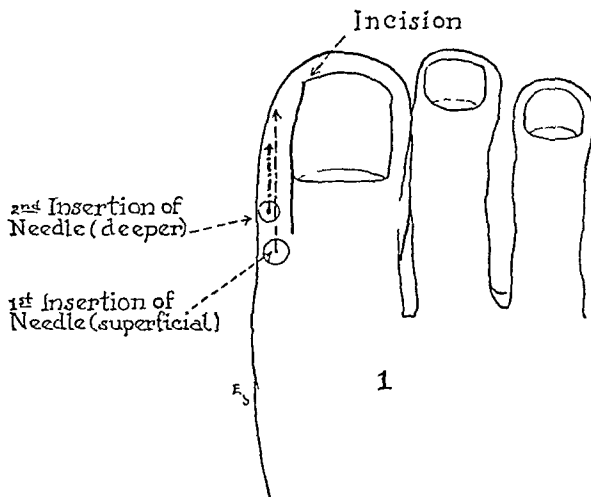


FIG. 1.

and trauma, with the inevitable tendency to form tender granulation tissue. By the time the average case reaches the office, the surrounding soft parts are thickened

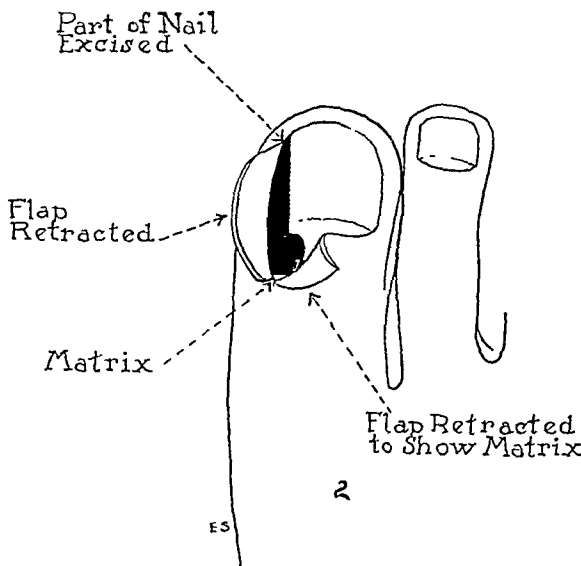


FIG. 2.

and infiltrated, and palliative measures are a waste of time. Salves have usually been tried before the doctor sees the case, and in the past few years the patient has often secured temporary relief from epsom salts soakings.

Palliative measures, such as gauze soaked in celluloid solution, laid under the

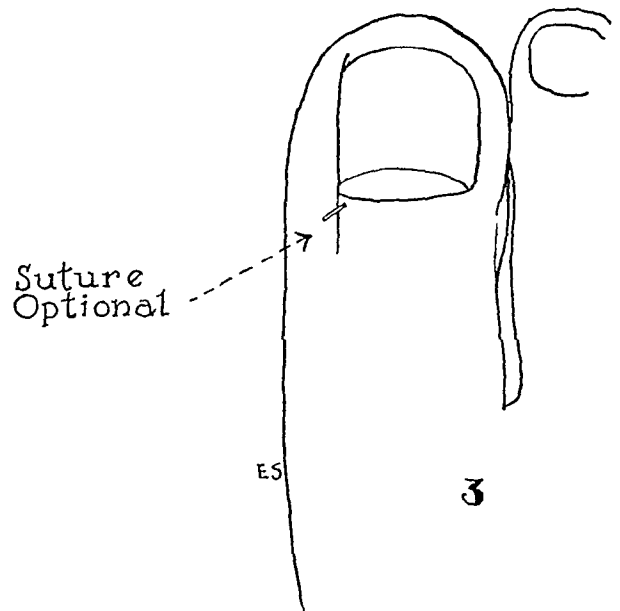


FIG. 3.

temporary relief. Micker of Berlin uses the former method, repeating the process after a few days.

#### OPERATIVE TREATMENT

The main object being to secure permanent relief by preventing recurrence, operation is aimed at the section of matrix from which ingrown section of nail is formed. If this matrix is not destroyed, nothing permanent has been accomplished.

If the case presents badly infected toes, a dehydration of the tissues by soaking in a strong solution of magnesium sulphate greatly lessens the angry appearance, and shortens the healing time. For two or three days before operation, the patient is asked to carry out this soaking for twenty to thirty minutes twice daily. He is also asked to bring a soft slipper to wear home after the operation.

After iodine and alcohol preparation of the skin of the entire toe, a rubber band ligature is placed around the base of the toe to secure hemostasis. The operative field is surrounded with sterile towels, and with a 2 c.c. Luer syringe a solution of

1 per cent novocaine, with or without adrenalin, is injected into the dorsal surface proximal to the matrix, pushing the needle forward and injecting up to the base of the nail (Fig. 1), then around toward the plantar surface on the side to be operated on, and lastly proceeding distally to the end of the toe, injecting deeply in the last part. If both the edges of the nail require removal, a similar injection is made on the opposite side.

The technic of Von Bergman of the Roosevelt Hospital has been found very satisfactory. Within two or three minutes after the injection of the local anesthetic, incision is made on the dorsal surface, beginning at the cutaneous junction 1 cm. inside of the mesial border, and extending 1 cm. backward so as to expose the whole depth of the matrix at this point when the flaps are retracted. (Fig. 2.) The incision is then carried forward along the mesial side of the nail to the distal end. The flap is so dissected that the entire nail edge and corresponding matrix is exposed, leaving the epithelium of the nail sulcus to be removed with the nail margin. The lateral margin of the nail is now excised, together with its matrix and nail sulcus, and with a small sharp curette all particles of the matrix and epithelium and scar tissue are removed.

The flap is now replaced (Fig. 3) and most operators do not use stitches, but press the flap down firmly and gently bandage over a vaselined gauze compress dressing. In cases where there is but little inflammation, one stitch placed where the incision was begun at the nail border

seems to facilitate union, and does not interfere with drainage.

The soft slipper is worn for a week, dressings being changed daily for the first three days, then every second or third day until healing is complete. It is always necessary to soak off the first dressing but not subsequent ones. The patient should not use the foot for three days.

After ten days an ordinary shoe may be worn, provided the patient has remained off the foot for the first few days. Rapidity of healing is in direct proportion to the length of time the patient remains off the foot after the operation.

The above procedure is practically that of von Bergman at Roosevelt Hospital; the "one-slice" operation of cutting, which the writer has seen others do, leaves much scar and thereon much tenderness with slower healing.

G. E. Ney's method pays no attention to the nail, removing soft parts only, saving skin flaps to cover the area from which the tissues external to the nail have been removed. It may be successful if it is followed by correct trimming and correct footwear.

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# RATIONAL USES OF PHYSICAL ENERGIES IN OTO-RHINO-LARYNGOLOGY\*

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EFFORTS to rationalize the uses of light, heat, and electricity in oto-rhino-laryngology have occupied workers for more than a decade. The administration of thousands of treatments with physical agents in affections of the ear, nose and throat has resulted in the accumulation of a vast amount of clinical evidence, an analysis of which has enabled the writer to present this resumé of the subject. It is admitted that often the work was carried on strictly for experimental purposes, with no more sound indication than pure empiricism. At other times, the enthusiasm of successes in small series of cases warranted thorough and painstaking trials over a space of time. And still during some periods, the suggestions and experiences of foreign and American investigators in the field seemed to offer sufficient inducement to carry on clinical researches, even though personal endeavors had previously been convincing of either failures or results inferior to those obtainable with customary procedures. These are reasons sufficient to justify the efforts expended, for in no other way would it be possible now to arrive at some definite conclusions concerning the status of physical therapeutics in the specialty. Unfortunately, the amount of laboratory experimentation has been limited. However, as has been stated, an overwhelming collection of clinical data is available, and this must serve as the criterion until more basic studies are made.

## RADIANT HEAT LIGHT AND INFRA-RED THERAPY

The utilization of infra-red and luminous rays in oto-rhino-laryngology has served primarily in the acute infections. The infra-red is characterized by

long wave lengths, the luminous rays by shorter wave lengths. The former extends from 64,000 to 6500 Angstrom units; the latter from 8000 Å. units in the red to 3900 Å. units in the violet. The principal local effect of infra-red radiation is the production of hyperemia. Luminous rays have relative photochemical properties, while the immediate action is that of hyperemia and stimulation of lymphatic circulation. All wave lengths of radiation appear to possess some heat properties and the ability to influence chemical reactions. The sources of such radiation are used for palliation of pain or for retardation of inflammatory processes.

That heat may relieve pain is an accepted fact. It acts by diverting blood from congested parts through the production of a collateral hyperemia or the relief of vascular stasis. Heat may lessen nerve sensibility, the result of inhibition acting through the temperature nerves of the skin. The production of hyperemia by the application of heat to a part raises the local tissue resistance by (1) an increased local nutrition, (2) an increased metabolism, and (3) an increased number of phagocytes in the tissues.

*Acute Otitis Media.* In acute otitis media two immediate factors are definitely called for: (1) relief of pain, (2) drainage. Heat has long been used in this disease for its analgesic properties. Either the infra-red or the radiant heat lamp is superior to any of the older heating sources. The radiation is more uniform and more easily controlled. Its action is decidedly more pronounced. Heat radiation, from any source, is not, however, a substitute for paracentesis of the drum membrane, if this procedure is definitely indicated. Its value is in no way lessened after

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paracentesis has been performed, for here again heat is the measure of choice, and the facility and satisfaction of applying either the infra-red generator or the radiant heat lamp are well recognized on the basis of clinical experience. Drainage is more quickly promoted and continued and the progress of inflammation retarded. Factors in the treatment which influence results are: (a) good apparatus, (b) long applications at regular intervals, (c) regulation of apparatus and adjustment of distance from ear, permitting radiations of thirty minutes without intolerant effects or untoward reaction of skin surface.

*Acute Nasal Sinusitis; Acute Coryza.* After the usual treatment providing increased ventilation and drainage, the application of radiant energy has acted as a valuable aid. The principle underlying the application of heat in acute sinusitis is well established. The suggestion here is simply that of an improved source, either the infra-red generator or the radiant heat lamp.

There are practically no contraindications for the application of either the luminous rays or infra-red in acute disease. It is extremely important, however, that their continued applications be not depended upon to do what surgery or other measures usually accomplish promptly. They are not substitutes for other methods of treatment, but, as has already been emphasized, the sources of the energy are improved means of heat generation by which such physical force can be applied in a simple manner and with maximum effects.

#### ULTRAVIOLET LIGHT

The spectrum of sunlight is limited on one end by infra-red and on the other by ultraviolet rays. The ultraviolet rays are obtainable from the sun, and to some extent by reflection from other natural sources. Artificially for therapeutic purposes, this energy is obtainable from carbon or impregnated carbon arc lamps and from quartz mercury vapor burners.

The data upon which conclusions are drawn in this report is based altogether on mercury vapor quartz lamps, the water-cooled for localizing action and the air-cooled for systemic effect. Ultraviolet rays penetrate tissue much less than 1 mm. The ratio of penetration between skin and mucous membrane is not definitely known, but a comparison of tolerance between mucous membranes of different organs has been worked out roughly by clinical observation. Thus the tolerance of the mucous membrane of the pharynx is small as compared with the tolerance of the mucous membranes of the nose, the ratio being about 1:10 in the average patient. Certain factors influence the tolerance of ultraviolet irradiation of mucous membranes, the chief ones probably being the vitality of the tissue, the presence of excessive moisture and unusual amounts of mucous or other secretions.

As compared with the wave lengths of the other rays already described, ultraviolet ranges from 4100 to 1860 Å. units. Ultraviolet radiation such as is normally present in sunlight tends to stimulate the endogenous growth of cells, accelerates the life cycle and therefore hastens death, whereas the longer wave lengths of light are necessarily of exogenous development and the continuation of growth and repair of waste in the cell.

Ultraviolet radiation has a bactericidal action, which is, however, very superficial. Intense radiation has a destructive action on tissue cells. Ultraviolet light produces certain changes in the blood. The speed of reaction is influenced, both the oxidation of chemical compounds in the presence of oxygen and their reduction in the absence of oxygen. Respiration is influenced, breathing becomes slower and deeper. Other changes have also been noted, further work being necessary to act as confirmation.

*Pharynx and Oral Cavities.* Opportunities to treat tuberculosis and lupus of the pharynx and oral cavities are not so great in clinic and private practice. The few cases which have been attended responded favor-

ably. As Cemach has remarked, "Owing to their easy accessibility, oral and pharyngeal mucous membranes have been proved to be the most satisfactory objects for local light therapy." Cemach's series consisted of 13 cases thus treated, tuberculosis of the pharynx 3, of the cheek 3, of the tongue 2, of the gums 1, and further 4 cases of lupus. Twelve cases were cured completely, while one was only improved. Cemach also quotes Wessely who treated 35 cases with 28 recoveries, and Schreyer who treated 15 cases of lupus with 14 recoveries. Spitzer (Lupus Institute, Vienna) has treated 6 cases of acute tuberculosis of the oral membrane with good effects.

In disease of the tonsils little or no curative action is obtained with localized ultraviolet irradiation. This, in spite of the fact that many enthusiasts claim all sorts of favorable reactions. In isolated cases, occasionally, some good results were obtained, but the difficult problem of controlling these results renders them questionable. Likewise, the uniformly good results of some in treating Vincent's angina with quartz light have not been duplicated by the writer.

*The Nose.* Skin conditions of the external nose sometimes respond favorably. This has special reference to the eczematous eruptions. Acne rosacea is rarely affected. Tuberculosis and lupus of the nasal membranes, unless easily approached, do not react well to ultraviolet, although frequently this agent serves as good adjunct treatment. So far as other localized intranasal diseases are concerned, ultraviolet irradiation cannot be said to produce uniform results of any kind. Now and then a favorable action is secured. In general it may be said that ultraviolet light produces a bactericidal action on that part of the mucous membrane which the radiation reaches, this action for certain organisms varying with the radiation time. There is nothing accomplished in nasal accessory sinus disease by intranasal irradiation of quartz light.

*The Ear.* Skin affections, especially

lupus, react well to ultraviolet irradiations and good results are the rule. Certain types of middle-ear suppurations frequently improve, and in some, suppuration ceases when treated with quartz light. No definite indications can be made and the only test is the therapeutic one. Cemach states that middle-ear tuberculosis reacts to all forms of ultraviolet light. He also recommends the resorbing effect of the quartz light as postoperative treatment of septic ear cases. This appears to be a logical and reasonable indication.

*The Larynx.* What has been said regarding the treatment of tuberculous conditions of the pharynx and oral cavities applies here. Few cases remain under treatment at the clinic, practically all of them sooner or later being referred for sanatorium care. No definite statements can therefore be made from personal observation. The largest number of cases reported upon in the literature is by Strandberg of the Finsen Medical Light Institute. A late communication embraces 203 cases, mostly of moderately severe and severe tuberculosis of the larynx. The majority of these were ambulatory cases of which number 55.6 per cent were clinically cured. Strandberg's methods include the use chiefly of general irradiation with carbon light baths without local irradiation of the center of the disease. The quartz light is employed on exceptional occasions.

#### THE GALVANIC CURRENT

This current may be derived from a wet cell, a dry cell or batteries, or from the lighting mains through a motor generator set. When the current from the mains is alternating in type a motor transformer or electrolytic rectifier is necessary to change it over to a direct current.

Galvanism is employed either for its polar effects or for the ionization of certain drugs or metals. Such terms as cataphoresis, anaphoresis, iontophoresis, ionic medication are more or less synonymous and vary only in technical detail. The action of the galvanic current is

primarily a chemical one. The contrasting reactions between the acid positive pole and the alkaline negative pole are proved by simple laboratory test. When applied to tissue the positive pole acts as a vasoconstrictor, the negative as a vasodilator. The action on metals of the two poles is sometimes of interest. The positive pole oxidizes and corrodes metals. The negative pole has no power of oxidation. It is said that the positive pole has distinct sedative properties in contradistinction to the irritant action of the negative pole. This sedative effect of the positive pole cannot, however, always be demonstrated clinically.

Ionization is defined as that treatment which consists in the introduction into the tissues of minute particles called ions by means of the electric current. Bases, metals and alkaloids are electropositive and therefore should be placed on the positive pole. Acids and acid radicals are electronegative and should be placed on the negative pole.

In otolaryngology, medical ionization has been used to advantage for two very definite indications, chronic suppurative otitis media, and chronic intumescent or moderately advanced hypertrophic rhinitis. It should be emphasized, however, that only selected cases of either of these conditions respond favorably to ionization.

*Chronic Suppurative Otitis Media.* The technic of zinc ionization as suggested by Friel is the only one which has been used. In selecting cases for this method an attempt has been made to follow the rules laid down by this worker. "Tympanic sepsis, meaning by this, infection of the discharge rather than infection of the living tissues, is clearly a case for antiseptic treatment such as zinc ionization." The perforation in the drum should be large enough to permit the zinc solution to enter the middle ear, or if this is not the case, a small cannula should be employed to introduce the fluid. Occasionally the ischemic action of adrenalin, or a combination of cocaine and adrenalin

solutions, serves to give better access to the perforation. Only simple uncomplicated chronic otorrhea is an indication for zinc ionization with anticipation of a curative result. Other types of middle-ear suppurations sometimes react favorably by way of improvement for longer or shorter periods of time, but the experience of many clinicians has shown that in the presence of any complicating pathology permanent cessation of the aural discharge does not occur. Friel advocates zinc ionization for indications other than mentioned, but the writer has limited himself both in his clinic and in private practice to this very definite indication.

*Nasal Zinc Ionization.* For intumescent rhinitis, and for mild forms of hypertrophic rhinitis, zinc ionization has been found to give more satisfactory results than many of the older non-surgical methods of treatment. The cases must be carefully selected, for there is no unanimity of opinion concerning the nasal structures involved. Likewise there is a difference of opinion on the part of some authors regarding the strict meaning of "intumescent" and "hypertrophic." In the early stages of simple chronic rhinitis, there are the usual inflammatory changes in the mucous membranes, but the thickening varies according to the duration and severity of the nasal involvement. The term "intumescence" implies a swelling, but not necessarily one of permanence. As Phillips puts it, "In the hypertrophic or hyperplastic form, chronic rhinitis is an inflammatory process which involves the nasal mucosa, more especially the turbinal tissues and is accompanied by permanent increase in the soft tissues and changes in the character of the secretions." Markedly advanced rhinitis with fixed connective tissue or polypoid changes should be excluded as an indication for zinc ionization. The method of treatment of zinc ionization is simple and can be carried out in very young children as well as in adults. In older children, in particular, it is of merit because it sometimes relieves the

nasal symptoms of obstruction until such a time in adult life when surgery can be instituted if so desired. Long strips of narrow gauze packing saturated with a weak solution of zinc sulphate (0.5 per cent) are packed into the nasal chamber to be ionized. Every surface of mucosa should be covered down to and below the inferior turbinal. The moistened gauze is a conductor of electricity and when the current is turned on, only those parts will be ionized adequately which have been brought into the circuit by good contact. The positive pole of a galvanic current is connected with the wet nasal packing, the negative pole to a large wet pad on the forearm or other surface. As has been frequently stated, the current must be controlled from the lighting mains by a generator set. In fact, this is the most desirable plan at present, because the set has a milliamperemeter, polarity changers, indicators and such other refinements as make for perfected technic. Up to 10 ma. may be employed for from ten to fifteen minutes. The maximum effect should be reached after ten minutes. As a general rule only one ionization is necessary, but occasionally a second or a third treatment makes the result of relatively longer duration. There is no reaction which causes any discomfort to the patient. Definite changes in the appearance of the surface of the mucous membrane occur. These are referable to color and presence of secretions, both of which are altered immediately, due to the surface action of the zinc and the pressure of the packing. The electrolytic effect is undoubtedly also a surface one, but must be studied microscopically to be described accurately.

F.H.B. Norrie advised the use of zinc electrolysis for enlarged inferior turbinates, as an alternative to the cautery or turbinectomy. Its chief advantages are absence or minimum reaction and no destruction of nasal tissue. Norrie uses preliminary cocaineization. The needle is inserted into the turbinal and pushed along it under the mucous membrane and close to the bone for whatever distance is considered neces-

sary, care being taken that the needle does not puncture the mucous membrane again further back. The current is increased up to 10 ma. and continued for ten minutes, after which it is slowly reduced and reversed for a few minutes so as to allow easy withdrawal of the needle. A pure zinc needle, properly insulated, is essential for the avoidance of burns of the mucous membranes.

#### DIATHERMY

To the best of our present knowledge, diathermy is a form of thermotherapy which utilizes electrical energy for the production of thermal effects in the depths of the tissue. The rise of temperature is said to be proportional to the amount of resistance encountered by the current. Medical diathermy is differentiated from surgical diathermy by the destructive action of the latter which is produced by carrying the heating effect beyond physiological limits. Whether heat is the one and only physiologic action of diathermy is at present a mooted question. If other effects are produced they have not as yet been conclusively demonstrated either by laboratory or clinical tests.

The chief indications for diathermy are deep seated affections. In such it may be employed independently or combined with other agencies such as galvanism, sinusoidalism or the x-ray.

A diathermic current has no polarity, and therefore reference to polar action or usage is erroneous. It is said that heat is generated in the tissues in proportion to the square of the amperage employed and the resistance of the tissues to the passage of the current. It has been stated also that the high frequency current because of its high voltage, is probably able to take a direct path through the tissues and is not influenced materially by their relative resistance. This latter contention has not been conclusively proved and is therefore open to argument.

Briefly the physiologic effects of medical diathermy may be classified as local and



general. Logically the resultant action of diathermic application include (1) mild skin hyperemia, (2) sedation, (3) improved blood and lymph circulation. Factors which will alter the degree of either of these actions are duration of treatment, size of electrodes and frequency of administration. When uniterminal diathermy is used, because of the higher frequency and higher voltage, the heat produced is more superficial and cannot be localized or directed into deeper tissues. The body acts as a condenser to these currents which are easily diffused and dispersed and not easily controlled. The local effects of surgical diathermy depend on the intensity of tissue destruction desired, and this depends on the utilization of electrocoagulation, electrodesiccation, or fulguration. When either of these is employed, marked reaction of the tissues takes place. Edema and sloughs are of common occurrence.

The general effects of diathermy, aside from the slight elevation of body temperature, are more or less conjectures. It is true that a lowering of systolic blood pressure has been noted, but this lowering is usually not of a permanent nature except in isolated cases. In otolaryngology the local effects of diathermy are of chief importance. Therefore, further consideration of the general action will not be discussed.

*Nasal Accessory Sinus Disease.* Before applying medical diathermy to a diseased nasal accessory sinus, the case must be carefully selected for this treatment. Clinical diagnosis should be supported by roentgenographic evidence so far as this is possible. Diathermy is not indicated in the presence of pus in a sinus cavity unless adequate drainage has been provided, nor is diathermy indicated in any instances in which surgery has been established as the rational therapy. An example of this is polyposis or polypoid degeneration of the mucous lining. There are numerous instances, however, of sinus disease without surface suppuration of the mucosa,

which give symptoms of pain or discomfort, and tenderness. Irrigations often prove valueless. Surgery might prove beneficial, yet conservative measures merit a trial first. It is for such an indication that diathermy has proved beneficial.

The frontal and maxillary sinuses are easily accessible and lend themselves to direct diathermy. Heat within the tissues of the sinus cavity is effected by this method. It is analgesic in acute, subacute and chronic involvement, lessens symptoms by its ability to produce a local active hyperemia and improves the blood and lymph circulation to the part. Thus tissue drainage is promoted.

Experience has demonstrated that whereas the frontal and maxillary sinuses respond favorably to diathermy when heat is an indicated factor in the treatment, inaccessibility of the sphenoid and ethmoid sinuses has caused difficulty in the technical application of the direct method. The results in sphenoid and ethmoid disease have not been satisfactory, and until scientific means of administering the energy are devised, negative results may be anticipated.

The value of diathermy as an aid in the postoperative treatment of sinuses has recently been suggested. This is especially noteworthy when healing is delayed for some reason, such as devitalization of the part. On the whole, diathermy cannot be said to replace any of the usual procedures, medical or surgical. It is, however, an added means at our command for conservative therapy and should be thoroughly tried, particularly when other methods have been ineffective. Results will depend on correct technic, good apparatus and individualization of treatments, based on the existing symptoms and pathology.

*Chronic Middle Ear Deafness.* An analysis of over 300 records of patients with middle-ear deafness selected for diathermic treatment shows that improvement was obtained in 50 per cent of the cases. In each instance the diagnosis was made by

the usual tuning-fork tests and by the whispered and conversational voice tests. The audiometer was used as a final aid and also in checking progress of patients under treatment.

The method of diathermic application consisted of placing the smaller or active electrode over the mastoid region of the affected ear and the larger or indifferent electrode on the opposite side of the face, approximately over the area of the malar bone. Three to six treatments were given weekly, each treatment being of twenty minutes' duration.

Diathermy has benefited some patients with middle ear deafness after other methods had failed. In the experimental studies conducted during the past six years, cases were always carefully selected on a treatment basis and controls employed to evaluate each form of therapy, singly or in combination. Routine measures are never contraindicated. On the contrary, they sometimes are more effective with the adjuvant use of diathermic therapy.

Physical agents have failed to yield favorable results in advanced middle ear deafness, and in otosclerosis and nerve deafness. In fact, exaggeration of symptoms has been frequently noted when these types of impaired hearing have been under the influence of diathermic administration.

There is still much to be accomplished in the treatment of partial deafness with physical methods. General utilization by otologists of diathermy and other physical agents is warranted, not only on the basis of the experimental work already done, but in the hope that further progress will result.

#### OTHER USES OF MEDICAL DIATHERMY

Medical diathermy has been used experimentally and empirically for a number of affections in otolaryngology. There is yet to be established a definite rationale for indications other than those already discussed. There is little doubt concerning the value of uniterminal diathermy for

certain endonasal indications, but until further evidence is presented to augment what proof is now available, its employment must be regarded simply as an empiric form of therapy. Diathermy is now being utilized in chronic non-specific laryngitis and tracheitis. Further work is necessary to demonstrate its merit for these affections.

#### SURGICAL DIATHERMY

As a local agent for the destruction of new benign or malignant growths, surgical diathermy represents one of the true advancements of modern surgery. Its usefulness lies chiefly in its ability to destroy accessible growths with a minimum of hemorrhage and without danger of dispersing cancerous cells. Various technics for electrocoagulation have been suggested. The cutting current is now extensively employed for mass extirpation. No one method has proved ideal. Individualization is essential and the surgeon who adopts a certain technic on the basis of surgical indications will obtain the best results.

Surgical diathermy is the agent of choice for malignant growths of the antrum, the tongue, the lips or the larynx. Complete and permanent eradication of accessible neoplasms of the ears, nose, or other easily approachable parts of the head and face will depend on the type of growth encountered. Biopsy is important and histologic study of the removed tissue is always necessary to determine the value of follow-up treatment.

Carcinoma of the larynx can be approached in two ways: by suspension preceded by tracheotomy, or by laryngofissure. Obviously the choice of approach will depend on the extent of the growth and the condition of the patient. The permanency of results can only be predicted by the absence or presence of metastases. The difficulty has always been in getting patients early enough, before the glands have become involved, for the prognosis

is in direct relationship to the localization of the growth.

The problem of anesthesia in connection with surgical diathermy has always been seriously considered. Much work has been done with rectal and spinal anesthesia. Certain new drugs have been tried. The matter is still unsettled, but with the experimentation now being indulged in some good should result.

#### SUMMARY AND CONCLUSIONS

1. While physical therapeutics in otorhino-laryngology is still more or less experimental, a vast amount of clinical evidence is available to prove the usefulness and rationale of certain physical energies in selected cases which come in the scope of the specialty.

2. Radiant heat-light and infra-red are serviceable in acute otitis media, preoperatively and postoperatively, and in acute upper respiratory infections.

3. Ultraviolet energy has proved beneficial for tuberculosis and lupus of the

pharynx, larynx and oral cavities and for some skin affections of the nose and ear.

4. Zinc ionization for selected cases of chronic suppurative otitis media and for intumescent and moderately advanced hypertrophic rhinitis represents a definite advance in the therapy of these diseases.

5. Medical diathermy is of value in acute and chronic forms of frontal and maxillary sinusitis, but must be employed with due regard for underlying factors, principally that of drainage when suppuration is present.

6. Middle-ear deafness is an indication for medical diathermy, especially after the usual methods have failed to bring about improvement. Recent reports by Hilliard and McKenzie appear to confirm the results reported upon earlier by some foreign and American otologists.

7. Surgical diathermy is unquestionably the agent *par excellence* for the destruction of accessible new growths, whether benign or malignant, providing, however, there is absence of metastatic involvement.



## THE SEDIMENTATION TEST

### A SUBSTITUTE FOR THE LEUCOCYTE COUNT\*

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NUMEROUS articles have appeared in the literature from time to time on the erythrocyte sedimentation test. Friedlander in this country was among the first to advocate its use. Baer and Reis, Polak and Mazzola, Schmitz and Schmitz, and others, have reported their experiences. Opinion is almost uniform that taken in conjunction with the physical findings, the sedimentation test is of definite value to determine the presence or absence of infection.

The rate of settling of the red blood cells from a citrated column of serum,

when allowed to stand, is known as the sedimentation time. While its use has been more or less confined to hospitals, and especially to gynecological departments, the simplicity of technic makes it both practical and valuable for office practice.

#### TECHNIC

Draw 0.2 c.c. of a 5 per cent sodium citrate solution into a 1 c.c. graduated tuberculin syringe. With a small hypodermic needle attached, draw 0.8 c.c. of blood from one of the small veins in the

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arm; thus making 1 c.c. of a solution of citrate blood, which is placed in a standard calibrated tube. Shake thoroughly by in-

	Minutes
Normal pregnancy.....	110
Postpartum afebrile.....	52
Abortions, 2 to 3 mos.....	68

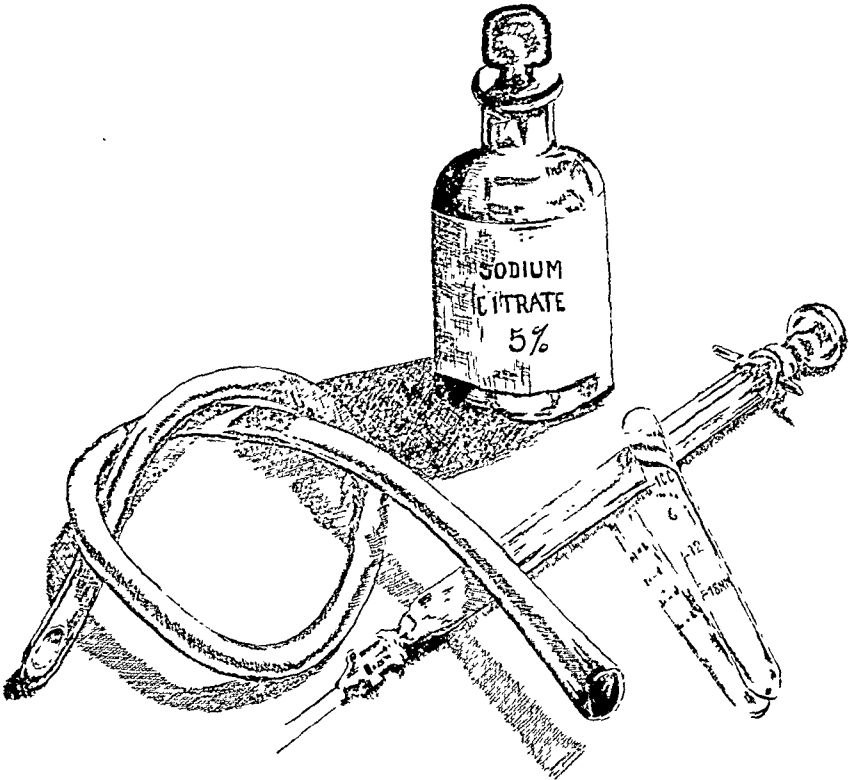


FIG. 1.

verting the tube, and take the time. When the erythrocytes have settled to the 18 mm. mark, leaving the clear serum above, take the time again. The difference in minutes is the sedimentation time.

The normal rate for the average healthy individual is about 120 minutes. The following readings show some of the common infections and their locations:

	Minutes
Infected abortions.....	30
Pelvic abscess.....	16
Breast abscess.....	23
Active salpingo-oophoritis.....	38
Parametritis recent.....	36
Fibroids and pelvic infection.....	65

When the rate is below thirty minutes, localized accumulation of pus either in definite abscess formation or in minute foci will be a constant finding.

Certain conditions named below show rapid readings not accounted for by infection:

Here some absorptive phenomena must account for the rapid settling of the cells.

In malignancy, the rapid readings are due to a secondary infection of the malignant growth.

Following operation the rate drops thirty or forty minutes, but within a week's time it is again nearly normal. The absorption from tissue destruction may account for this change.

In secondary anemia the rate is not materially altered; when it is, a careful search for foci of infection will usually explain the change.

In elective operations, one is certain to meet with cases where although physical findings and the temperature are normal, infection is suspected. It is in this type of case that the test is of most value. Whenever the rate is below ninety minutes, operation should be postponed until the

rate is normal or sufficient time has elapsed under conservative treatment to make it apparent that operative interference is essential for recovery.

In fibroids associated with pelvic infection, the rate in 37 cases examined at the Long Island College Hospital in Brooklyn was sixty-five minutes. In every case foci were found to substantiate this determination. In most cases under expectant treatment the rate would approach normal in a few weeks, and operation was then performed. When cases were operated upon with a sedimentation time of less than ninety minutes, the postoperative course was attended with more complications, and the convalescence prolonged. The end-result of the operative procedure was also less satisfactory.

In the diagnosis of ectopic pregnancy of recent origin or rupture, the sedimentation rate will be normal. In 25 such cases the average rate was 108 minutes, compared with 32 of acute salpingitis, showing an average rate of thirty-six minutes. In both conditions the physical findings, leucocyte count, and temperature may be entirely similar. A slow rate, or one approaching the normal, will suggest ectopic pregnancy, while a rapid rate will indicate that an active infection exists. In old ectopic cases, rapid readings are due to infection of the blood clot in the peritoneal cavity.

A tubal insufflation test should never

be done in the presence of infection. A sedimentation rate will diagnose infection, if present.

If a test aids our diagnostic methods, it will be added to routine laboratory analyses in hospitals; but, if it is the least bit difficult it cannot be used in office practice. The leucocyte count is not done in most physician's offices unless he is equipped with a laboratory technician. The solution and pipettes require considerable care. A microscope is also necessary. The information obtained by leucocyte count is no greater than that determined by sedimentation. In addition the sedimentation rate is much more simple, requires no elaborate technic, and may be done by anyone in his office capable of doing a venous puncture.

#### CONCLUSIONS

1. A rapid rate means infection, a slow settling of the red blood cells eliminates this possibility.
2. It can replace the leucocyte count because it gives as much information and is not subjected to so many changeable factors.
3. The diagnosis of latent or quiescent infection is a valuable adjunct to elective surgery.
4. It will be found to be of value in diagnosis of ectopic pregnancy.
5. It is simple to perform and therefore may be used in office practice.



## REMOVAL OF FOREIGN BODIES FROM HANDS, FINGERS AND FEET\*

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THE frequency of the incidence of foreign bodies in the hands and fingers and the relative ease with which those more superficial can be excised, makes the problem of their removal of inter-

est not only to the surgeon but to the general practitioner as well. That often the search for foreign bodies taxes the patience and skill of the operator would indicate that unless the offending body is superficial

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and easy of approach, it were best left for removal in the hands of those trained by experience to do this.

Because the relative frequency of foreign bodies in the hands and fingers is much greater than in the feet, and since the principles advocated apply to both, this article will concern itself chiefly with the removal of foreign bodies from the hands and fingers and limit itself to those foreign bodies visible in the x-rays.

Certain general principles applicable to foreign bodies anywhere, and to the hands and fingers particularly, present themselves as a working basis in the management of foreign bodies, as follows:

1. Most foreign bodies are a source of irritation, either immediate or remote, and wherever possible should be removed.

2. Early removal makes for easier removal and prevents slipping and progression of the foreign body along the tissue planes.

3. Where the foreign body is sharp and pointed, as a needle, pin, nail, etc., early splintage of the part maintains the relation of the foreign body to the tissues similar to the time of entrance and makes localization and removal easier.

4. The introduction of a foreign body into the tissues not made with surgical intent produces an infected punctured wound which should be sterilized by the injection of  $3\frac{1}{2}$  per cent tr. iodine by means of a hyperdermic needle, if the condition is seen early.

5. Where contamination by street dust is suspected, a prophylactic injection of tetanus antitoxin should be given.

6. Localization of the foreign body should be made before any attempt at removal is initiated as it saves embarrassment and facilitates the operation. For this purpose the use of a skin marker after visualizing the foreign body by means of the fluoroscope and projecting on the skin its approximate localization, is of material aid. X-rays in two planes, anteroposterior and lateral, should be before the operator while working, thus determin-

ing the relation of the offending body to the hard parts and the vital soft structures. The use of the tell-tale marker preliminary to the x-ray is of decided help in some cases. The use of the fluoroscope, where available, is of great value in extracting foreign bodies. Where neither the x-rays, nor the fluoroscope are available, transillumination with a strong light in the dark may give a clue as to the location of the foreign body. Discoloration of the deeper parts by the foreign body in its passage into the tissues may be a clue to finding it.

7. Anesthesia, either local or general, should be used. Where local anesthesia is used,  $\frac{1}{2}$  per cent novocaine solution injected at the root of the fingers to block the digital nerves for finger work; or at the wrist to block the median and ulnar nerves for palm work; or infiltrated locally over the foreign body, produces adequate anesthesia for the removal of the ordinary foreign bodies. Where the foreign body is located in the hard parts and requires bony excision, general anesthesia is preferable.

8. Drainage. Assuming that every foreign body not introduced aseptically may produce an infected wound, we prefer to drain every operative wound after the removal of the foreign body. For this purpose we use a sterile rubber-band drain.

9. The use of natural or electro-magnets has, in our experience, proved most ineffectual in the removal of foreign bodies of the hands and fingers.

10. While it is the writer's conviction that the best surgical work can be done only under proper condition, preferably in an operating room, yet where the foreign bodies are in the fingers or superficially situated in the hand, they can be removed at the office.

Surgery of the hand and fingers presents a difficult problem both because of their anatomic structure and function of these parts and because of the susceptibility to, and easy destruction by infection of some of the more important structures

found here. The sloughing of tendons as well as destruction of the phalanges, following hand infections, with subsequent

important anatomic structures here (digital vessels, nerves and tendons), and incises parallel to these. If the offending object



FIG. 1. Foreign body imbedded in head of metatarsal of little toe.



FIG. 2. Skin marker almost overlapping foreign body.

deformity of the fingers are well enough known to be mentioned here only in passing; and it is because of the easy destruction of these structures that any operative procedure undertaken here should be looked upon in the light of a major, rather than a minor surgical problem. The relative functional value of the different fingers should also be considered, and it should be remembered that they are important in the order named: thumb, index, middle, little and ring fingers. Foreign bodies are potential sources of introducing infection and, therefore, are important factors in hand infections.

#### PROCEDURE OF REMOVAL

*Fingers.* When a foreign body is situated in the fingers its removal is often an easy matter if one bears in mind the

is elongated and parallel to these structures, the usual incision, bisecting the foreign

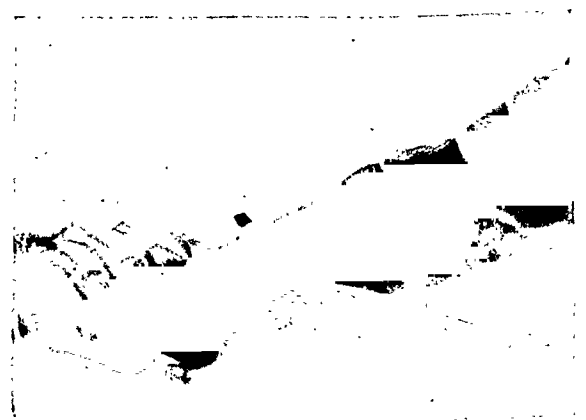


FIG. 3. Skin marker projected approximately over foreign body.

body, is made with a knife through the skin only, and further exploration is made with a blunt instrument, as an artery clamp,

until the familiar gritting sensation of metal-to-metal contact is sensed, and the object is grasped and extricated. When possible cutting across the pad-like cushions at the tips of the fingers, as well as the anterior surfaces of the closed spaces, is to be avoided, as scarring here may interfere with the important tactile sensation located over these areas. Where the foreign body is impacted in the bone, it is best approached from the side of the finger, making a generous incision for an adequate exposure.

*Hand.* In the palm, searching for foreign bodies becomes more difficult, both because they have a deeper range of penetration here, and the anatomic structures are more extensive. The superficial and deep vascular palmar arches and the neural palmar arch as well as the numerous flexor tendons here should be remembered and avoided. Where the foreign body is superficially located, incision with a knife is made through the skin only, bisecting the foreign body and sufficiently large to give a good visual exposure. Blunt dissection with the tip of an artery clamp is then carried out until contact is made, as in the fingers. When the foreign body is deeply located, below the palmar fascia or in the palmar spaces, its removal may be quite difficult. It sometimes becomes necessary to make a more extensive exposure than a linear incision bisecting the foreign body gives, especially where the foreign object is a needle lying at an angle between  $45^{\circ}$  to  $90^{\circ}$  to the skin surface and deeply imbedded in the palm of the hand. A flap incision in the skin, either surrounding the foreign body; or one leg of the flap bisecting, or as nearly as possible bisecting it, gives the advantage of increasing the operative field by retracting the flap. A good visual operative field, which really means a sufficiently large operative field, is essential for good work.

The following case is cited to prove that sometimes an apparently innocuous foreign body of long retention may become the irritative factor in a symptom-complex simulating another disease:

J. R. a well-preserved man of sixty years, presented himself in 1926 with the following history and findings:

For the past five years he had been suffering from a symptom-complex consisting in periodic pain, swelling, redness, and disability of the right foot. The pain would come at night more often and was of sufficient severity to require opiates for relief. The weight of the bed-clothing would produce pain so that a cradle was used for that foot. Medical attention here and abroad consisted in symptomatic treatment during the attacks and the general hygienic and medicinal treatment for gout in the intervals between attacks. The attacks would last four to five days and the pain would gradually become less and remain so during the free-from-attack interval which would last about four to six weeks. He presented an x-ray taken abroad about three years before where he was told that the buck-shot lodged in his foot, which he remembered being in there about forty years, had no relation to his condition.

Examination of the blood serologically, chemically and cytologically was negative. The urine and general body physical examination were negative. The right foot showed an atrophic condition of the skin over the dorsum, otherwise the part was negative. Motion in the ankle and the joints of the tarsus and toes was normal. The free-from-attack period had lasted about three weeks at the time of presentation of the patient. An x-ray was ordered, and revealed the buck-shot as in the accompanying illustrations. Removal of the foreign body was advised and done. At operation the buck-shot was found buried in head of the metatarsal of the little toe with an associated periostitis of the metatarsal. Following the operation the patient had been watched and seen periodically for one year and during this time no attack has occurred. The removal of the foreign body stopped what seemed like a gouty symptom-complex.





# INDICATIONS FOR DOING A MEATOTOMY & A SIMPLE TECHNIC THAT CAN BE DONE IN THE OFFICE\*

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**A** NARROW meatus occurs in the distal 1 cm. of the urethral canal and is bounded by the external and internal meatus.

A narrow meatus exists in the infant when there is a small orifice that will not admit a No. 10 F. sound, and in the adult when it will not admit a No. 22 F. sound. The condition is the most frequent of any urological condition. It is the commonest cause of urinary obstruction with its serious sequel in infants. It is the most frequent cause of inadequate drainage of the urethra. The latter condition invites specific and promotes many non-specific infections. In cases there is an indication to instrument the urethra or bladder, it is the commonest hindrance. It may be congenital or acquired.

Meatotomy is one of the easiest and simplest of all operations. Yet it is probably the most neglected operation in the realm of surgery. The operation should be done in the office every time a narrow meatus is found to exist before attempting instrumentation of the urethra.

The technic I use is as follows: The end of the penis is washed with soap and water and the field of operation is anesthetized by inserting a cotton applicator soaked in 4 per cent butyn (adrenalin) solution. After this has been in the meatus for ten minutes, a sharp, blunt-pointed bistoury is inserted into the urethra, well within the second meatus, the head of the penis is compressed from side to side tightly, and the knife withdrawn, cutting the floor of

the urethra to a depth that apparently removes the obstruction and eliminates the pocket that exists behind it. The desired result in skillful hands should be achieved with a single stroke. It is important to remember that the internal meatus, at the depth of 1 cm., is often tighter than the meatus itself. A No. 28 F. bougie is introduced immediately. If it will not pass readily, or catches on the constriction as it is withdrawn, further cutting is required.

If adrenalin has been employed, the bleeding is usually slight, but gentle lateral compression should be applied by the operator until it subsides. The patient is instructed how to stop bleeding by lateral compression of the glans penis in case there is a recurrence. It has been my custom to apply half inch bandage bound with narrow strips of adhesive in such a manner that it compresses the edges of the wound, but permits the patient to urinate without removing the bandage. Then, I place a piece of sterile gauze over the end of the penis and fix it with a small rubber band. The latter is easily removed when the patient urinates. The patient is instructed to keep the wound anointed with sterile vaseline, and after three days, to keep the cut edges from healing by pulling them apart twice daily. No attempt should be made to pass a sound before one week has passed.

The results are uniformly good, and I have never seen any complications from a meatotomy other than slight bleeding, that is easily controlled by the patient.

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# THE TREATMENT OF PARAPHIMOSIS\*

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**P**ARAPHIMOSIS usually occurs when a phimosis has been forcibly retracted behind the corona glandis, and remains there to produce a constriction. The inflammatory causes are balanitis, gonorrhea, chancre, chancroid, and herpes. Immediate treatment is indicated to prevent edema, ulceration and gangrene.

1. A simple paraphimosis can invariably be reduced without incision, if the following details, as enumerated by Keyes, are observed, viz:

(1) The stricture must be pulled well back. Exceptionally, the mucous membrane is unfolded at the dorsum; this must be smoothed out by still further retracting the prepuce.

(2) The edema must be thoroughly squeezed from in front of the stricture to the shaft of the penis behind it.

(3) Reduction is then accomplished by forcing the stricture slowly over the head of the penis. It is futile to attempt to pry the stricture over the glans until the edema has been reduced.

A liberal application of vaseline to the glans and prepuce will aid materially in persuading the stricture to slide over the glans. If a patient and skillful attempt at reduction fails, the stricture must be divided. Under local anesthesia, two longitudinal incisions are made in the depths of the constricting ring, which is above the edematous mass of skin and subcutaneous tissue, through the skin and subcutaneous tissue dividing the stricture until the prepuce can be easily drawn over the glans. The incisions should be about 1 inch long, and had best be closed transversely according to Heinecke's principle. This will

enlarge the preputial orifice, cure the phimosis and prevent future paraphimosis.

2. In case a chancre or chancroid is the exciting inflammatory cause of paraphimosis, a bilateral slit (never a dorsal) should be made to make the source of infection accessible and to prevent the destruction of tissue. The quicker it is done the less obstinate the infection will be. Under local anesthesia, the mucosa should be divided with scissors down to the corona, and then the skin and subcutaneous tissue through and above the constriction until the prepuce is redundant. The division of the skin and subcutaneous tissue well above the constriction is important, because it eliminates the edema, and prevents the formation of that hard infiltrated mass on the ventral surface of the prepuce that always occurs after a dorsal slit has been made. A liberal incision extending 3 to 6 cm. above the stricture will usually suffice. Hemostasis is controlled by heat and ligation of the bleeding points with single No. 0 plain gut. This procedure will give good exposure to the lesions, and enable the operator to do dark-field examinations, and to treat the primary lesions and co-existing infection. Incidentally, there will be fewer cases of suppurative inguinal adenitis, and less destruction of tissue. The wound should be dressed with the flaps in their natural position to prevent constriction at their bases. The penis should be elevated. Continuous application of hot Thiersch's solution will be found to be very efficacious in controlling the infection. After the lesions have healed, an acceptable circumcision can be done, under local anesthesia, by amputating the flaps at their bases.

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# TUBERCULOUS LYMPH NODES\*

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LYMPH nodes when infected by the tubercle bacillus become enlarged and firm, are usually painless and are affected in chains or groups. They may reach a stage in their enlargement when they become stationary in size or may even recede, to enlarge again in a short time. The process may cease with a firm enlargement but commonly a secondary infection is superimposed and suppuration follows. When this stage is reached the fluctuant node may become reddened, painful and tender. Occasionally when treated expectantly, the suppurative process may disappear, but usually the course is progressive and unless incision and drainage is resorted to, the suppuration breaks through the skin and a sinus is formed which is long in healing. With this progressive disease of long duration the treatment is tedious and discouraging to doctor and patient, and the direction of the treatment is of utmost importance.

This condition is usually found in children and young adults, 71 per cent of Clute's series occurring in patients under the age of thirty. In this series, 65 per cent of the patients were female and 50 per cent of the cases were confined to cervical nodes.

The majority of patients affected with tuberculous lymph nodes seek medical help with the complaint of an unsightly tumor. The complaint of pain and tenderness is the exception. The surgeon is usually confronted with the problem of treating a young patient who demands a satisfactory cosmetic result with the loss of the least possible time.

## GENERAL TREATMENT

Fortunately the diagnosis of tuberculous nodes is a comparatively easy one to make, and once made, the proper procedure is to institute careful and systematic

general treatment to increase the resistance and improve the health of the patient. The point is well known, but commonly slighted, and often a diseased node is conscientiously treated without success, while the poorly nourished host is neglected. Such simple measures as a carefully worked out diet, regulated rest, fresh air and sunlight should not be advised, but made a detailed part of the treatment. In most clinics cod liver oil is routinely given over a period of three to six months.

## FOCI OF INFECTIONS

That the eradication of foci of infections is of great importance in the treatment of tuberculous nodes is not to be questioned. The teeth and tonsils are commonly considered the point of entrance of the tubercle bacillus. Davies-Colley and others think that tuberculosis results in a lymph node invariably as secondary to a pyogenic infection. In either case the foci of infection must be removed.

Diseased tonsils are undoubtedly causative factors in cervical tuberculous adenitis. Tonsillectomy may often be the only necessary operative treatment for the complete disappearance of the tumor. Tonsillectomy is of such prime importance in this condition that many surgeons advise it in all cases of cervical adenitis. The tonsils need not be apparently diseased, nor need there be a history of frequent attacks of sore throats or tonsillitis. It seems to be a matter of choice whether the tonsils are removed before or after a necessary excision of cervical nodes. This depends upon the stage of the disease in the nodes. In early cases without suppuration tonsillectomy would be advised pending decision as to radical excision. In the case of suppuration the local operative procedure should be ac-

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complished first. It seems unwise to attempt tonsillectomy at the same time as any cervical node operation although it is done with apparent safety in some clinics.

Other foci of infection, such as infected sinuses and external ear infections, should be carefully and energetically treated. The teeth are often symptomless harbingers of infection and should be carefully examined and x-rayed and abscesses and cavities eradicated. The scalp as a carrier of foci of infection is often overlooked, especially in children, whose pediculi may be the cause of continued scalp infection. The proper treatment of foci of infection is in a great measure responsible for the decrease in incidence of lymph node tuberculosis in the past decade.

#### LOCAL TREATMENT

There are two methods of treatment of tuberculous lymph nodes: (1) operative and (2) non-operative. Both are necessary and have their place in the proper handling of the case, the direction of the treatment depending upon the stage of the disease. The time element is often a question of importance to the patient and he may elect to undergo an operative procedure which will save time and expense, even though the chances of a cure by expectant treatment may be very good.

1. *Stage of Firm Enlargement.* During this, the early state of the disease, the choice of treatment is most important. It is at this period that the progress of the disease should be carefully watched, with the institution of the measures mentioned above. The lymphadenopathy may progress and recede in a relatively short time in the beginning stages and the patient usually demands local applications. Iodine and iodine salves seem to be most popular, but their usefulness is measured to a great extent by the psychic affect on the patient. Counterirritation is of doubtful value and care should be taken to warn the patient of skin burns. It is of course necessary to forbid any

local applications, especially those containing iodine, during the course of x-ray therapy.

Conservative treatment in the early stages of the disease is the wise procedure. Radical dissection has been given up as a routine procedure in most clinics because of the resultant unsightly scars and the chances of nerve and vein injury, and because of the usefulness of other conservative methods of treatment. Heliotherapy is of great value in the treatment of the lymph node involvement as is it in any other type of tuberculosis. Natural heliotherapy alone in selected sites is sufficient to cure tuberculous lymphadenopathy but when used in conjunction with other methods is most effective. The quartz lamp is valuable not only as for its general effect but also for its local application to the enlarged nodes.

X-ray therapy is probably the most valuable single conservative therapeutic agent in this stage of the disease. In Hanford's series the usual dosage was about one-third of the dose of filtered roentgen ray necessary to produce a slight erythema in an average person. The number of treatments was about ten, given over a period of four and one-half months. His results justify the use of x-ray in all cases during this stage of the disease.

Radium treatment has shown approximately the same results but its use is more troublesome and more expensive. Desjardins of the Mayo Clinic advises x-ray treatment as the method of choice, while Bowing, also of the Mayo Clinic, advises radium.

If the conservative method of treatment does not give results that are satisfactory the ultimate result is of course excision of the affected nodes. Hanford states: "When a small group of definitely enlarged glands has been present in the neck for two months or over, in a patient who has reached the age of five years or more, we believe that their early and complete removal is the safest and best treatment which can be instituted." Exci-

sion of the nodes of course assumes removal of all the diseased process but does not infer a radical dissection of a complete chain.

2. *State of Suppuration.* In this stage of the disease the treatment should be operative. Incision and drainage of a suppurating node, with removal of as much as possible of the diseased process, is the most effective procedure. Conservative treatment, such as repeated aspirations with injections of bismuth or iodine preparations, more often results in ultimate sinus formation than in resolution. Silcock describes a method of treatment by drainage with a linen thread but this and other similar methods are inferior to operative procedure. Some patients seek treatment for the first time with a suppurating node and demand conservative treatment, and in such cases we use at the New York Hospital Durante's solution as modified by Hitzrot, which is injected into the aspirated node. After incision and drainage of suppurating nodes the cavity is filled with this solution and the wound sutured in selected cases. The formula is as follows:

Iodine.....	1
K.I.....	1.5
Guiacol.....	5.
Glycerine.....	100.

For use in children 2 per cent guiacol is substituted.

3. *Stage of Sinus Formation.* X-ray treatment is found to be most effective in this stage of the disease and hastens the healing of wounds and sinuses. Heliotherapy is also of great aid in the healing of these wounds. When sinuses and open wounds are treated by x-ray the dressings should be simple. Hanford advises minute amounts of phenol in the sinuses with sterile petrolatum.

In the absence of x-ray treatment alternate dressings of balsam of Peru and the modified Durante's solution prove effective.

Sinuses of long standing which do not respond to such treatment need operation.

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## BUNION & HALLUX VALGUS\*

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THE subject of bunion and hallux valgus is presented with the aim of establishing the identity of each. It is believed that there are unquestioned evidences, as to type of pathology at the first metatarsophalangeal articulation, to be associated with each lesion. The cause of both conditions, as well as their non-operative correction will be considered. Either term is commonly permitted to imply the separate or combined pathology

of bunion and hallux valgus at this joint in almost any of its aspects. Albee<sup>1</sup> would consider the bunion and hallux valgus as synonymous and confined to abduction of the great toe.

To use these terms interchangeably for the mere pathological condition of enlargement and thickening of the bursa overlying the metatarsophalangeal artic-

<sup>1</sup> ALBEE. *Orthopedic and Reconstruction Surgery*. Phila., Saunders, 1919, p. 860.

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ulation is not correct. The word bunion is fittingly applied to such pathology, whether acute or chronic, but deformity

confined to the great toe; however, Da-Costa<sup>1</sup> considers the possibility of bunion over the same joint of other toes. The



FIG. 1. Miss G. Manifesting acute symptoms of bunion (bilateral). Condition overcome by corrective shoes.

in the location should not be included. The term hallux valgus, however, when used, should specifically imply deformity, a deviation of the great toe from the medial line to abduction. Ordinary hallux valgus is deformity which is secondary to an initial process, the bunion. It is not believed that there is either a congenital or hereditary predisposition to the bunion *per se*, although there is authority contrary to this opinion.<sup>1</sup>

A bunion is a painful, acute or chronic inflammatory thickening or swelling of varying intensity of the synovial membrane and overlying soft structures at the first metatarsophalangeal articulation. Strictly speaking this lesion is primarily looked upon as a bursa, occasioned through continuous trauma from pressure and friction over the medial aspect of the metatarsophalangeal articulation of the great toe and without bony deformity. The disturbance, considered as such, is

practice among orthopedic surgeons is to apply this term to an indefinite pathology at the metatarsophalangeal articulation of the great toe.

The bunion, when of the acute type, presents the following symptoms, appearing in about this order: First, pain on pressure, sometimes with fluctuation over the joint involved and pain with great discomfort during efforts at use; second, swelling over the joint which may further be associated with contusion evidences such as redness, abrasions and ecchymosis; third, the possible finding of a nidus for the development of infection. The predisposition to breaking down of the soft structures, overlying the bursa of the articulation, through friction and pressure must be apparent. Thus, when these soft structures give way, and with the susceptibility of this site to infection as well as dissolution, the simple bunion may become a severely serious issue. Operation might

<sup>1</sup> MOORHEAD. Traumatic Surgery, Phila., Saunders, 1917, p. 133.

<sup>1</sup> DA COSTA. Modern Surgery. Phila., Saunders, 1908, p. 653.

then be necessary even without any sign of valgus deformity.

Hallux valgus is an outward or abduc-

tion deformity of the first metatarsophalangeal articulation, of varying degree, the great predisposing factor being the bunion.

Where the problem of severe deformity



FIG. 2. Mrs. S. Severe type of hallux valgus with contractures (bilateral).

tion deformity of the first metatarsophalangeal articulation, of varying degree, the great predisposing factor being the bunion. The term hallux valgus implies abduction from the medial line or displacement of the great toe toward the other toes. It does not in any manner identify itself with what is understood by the term bunion. Hallux valgus as a deformity becomes an issue for correction according to its severity. The deformity itself, so long as it is not aggravated by an acute bunion, is often not of the painful type and as such may not require correction for the comfort of the patient. Frequently only because of the fact that one is unable to wear ordinary shoes with comfort, is operation considered. Where, however, severe symptoms are involved with this deformity, operation is the surest and best means for relief and correction. Hallux valgus of the moderate type may readily respond to corrective measures without operation through proper footwear and may possibly be further overcome with night splintage. Such measures can be facilitated by the patient who

occurs, often involving dislocation of the proximal phalange of the great toe, with difficulty in ambulation, operation becomes the most certain method for correction. Hallux valgus can be so readily prevented by overcoming the predisposing factors of bunion that there is no excuse for the existence of the condition. The bunion may swing toward the development of a hallux deformity but correct shoeing with time will readily overcome the tendency. The general impairment of gait occasioned from these lesions is so simply corrected with proper footwear that it is disappointing to see how the wearing of improperly fitted shoes is permitted to continue. This factor alone leads ultimately to the ever-increasing pathological problems of the fore part of the foot.

The chief contributing factor to the development of the bunion is faulty footwear and the predisposing factor to the development of hallux valgus is the bunion. Short fitting hosiery will encourage and aggravate these conditions but the main or common cause is improper shoeing. Shoes which are too lightly constructed

for proper weight-bearing and walking predispose to trauma of the digits. Then, too, because of the short shoe with high

langeal articulation. With continued wearing of a faultily constructed and short-fitted shoe the tendency to abduction of the great

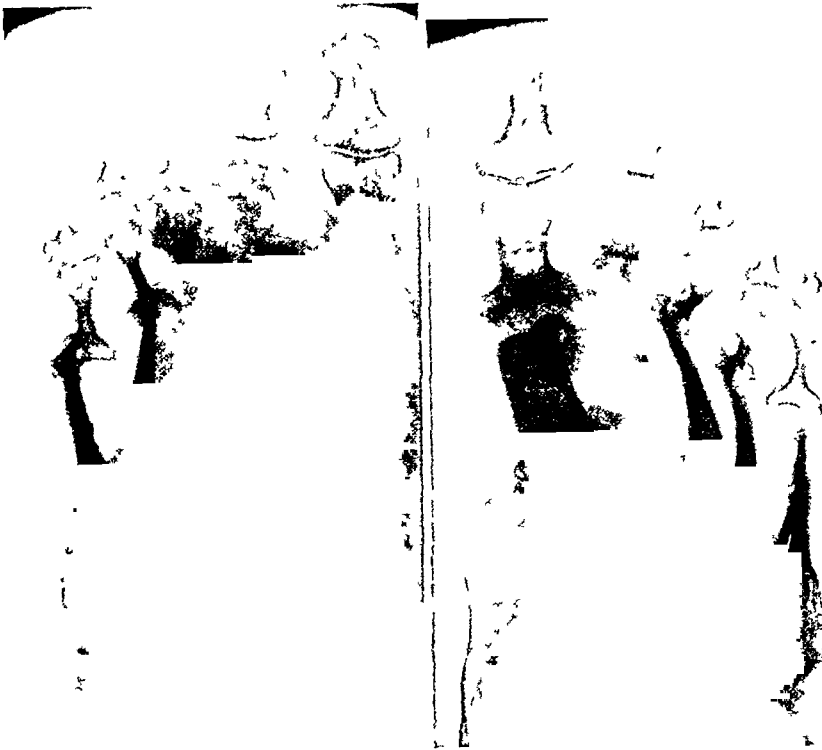


FIG. 3. Mrs. S. After correction by operative procedures

heel worn by women or the short shoe with narrow toe worn by men in their efforts to make the foot appear stylishly shod, there is a general tendency toward crowding the foot into an undersized shoe. Wearing such shoes bunches together the toes so that there is more or less abduction of the great toe with overlapping or underlapping of the second toe. There are also not uncommonly varying degrees of injuries with resultant pathology to the crowded digits. The commonest developments from such factors are inflammatory changes, contractures, deformities and callosities. Of this group the callosity, the simple corn or clavus, whether of the hard or soft variety, is most heroically endured.

From the crowding of the foot into the short shoe with the high heel or the short shoe with the narrow toe, there ultimately develops a permanent deformity of the toes and, more particularly for our consideration, of the first toe at the metatarsophal-

angeal articulation. With continued wearing of a faultily constructed and short-fitted shoe the tendency to abduction of the great toe goes on uncorrected and without the needed consideration. At this particular stage correct shoeing may readily overcome deformity and it is almost certain it will relieve the acute inflammatory process of bunion since by the discontinuance of pressure the exciting cause is removed. One possessing such a lesion cannot wear a physiologically correct shoe of the same size as the stylish type to which he has been attached. Instead of recognizing the mistake and desiring that the foot be placed in proper alignment with a correctly built and fitted shoe, the subject will endure the discomforts and harm subsequent to wearing popular shoes of stylish type. The impossibility of holding the great toe in the medial line becomes a problem because of the fact that the inflamed and swollen bursa over the medial aspect of the "bunion joint" will be too acutely involved to permit a correction. Then too the toe cannot assume the proper



alignment so long as the deformity is encouraged and maintained by the wearing of an improperly constructed and fitted shoe, from the viewpoint of anatomical structure. As this deformity continues, aided by support, inflammation of severe and deep character develops, and with further abduction of the great toe at the "bunion joint" the resultant deformity, hallux valgus, becomes a serious complication.

Thus, stimulation to bony formation through irritation about the distal metaphysis of the first metatarsal bone prevents any possible alignment with the former articulating proximal phalange. An apophysis or exostosis on the medial aspect of the joint is the result of this irritation and this spreading bony excrescence brings about in the extreme cases ultimate dislocation of the proximal phalange from the first metatarsal bone. It is this deviation outward from the medial line, whether of mild or severe character, which constitutes the lesion that should be identified by the term hallus valgus.

There is no reason for considering bunion and hallux valgus as one and the same lesion any more than there is for

identifying bunion with hallux varus, hallux extensus, or hallux flexus.

In brief it is desired to stress the fact that with proper footwear it is readily possible to overcome the formation of bunion and the ultimate development of hallux valgus. Further that the bunion usually finds origin from the predisposing factors: short hosiery, short shoes with high heels or short shoes with narrow toes. Also, that the common sequel from a bunion left unattended is hallux valgus, which deformity may present advancing pathology, encouraged through the continued wearing of improper shoes. The ordinary bunion is readily corrected without operation while hallux valgus, as a complication or sequel, is a genuine deformity which cannot be overcome without operation, unless it be of the moderate type. About 90 per cent of all adults are sufferers from some sort of foot trouble most of which can be prevented by proper shoeing. People refuse to realize that most of this distressing list of disturbances originates from the wearing of improperly constructed and improperly fitted shoes.



## WOUNDS OF THE SCALP AND FACE\*

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ONE room in every office should be equipped for the care of emergencies; a supply of dressings, sterile instruments, and sterile threaded suture material, arranged on a small portable table ready for immediate use, is the minimum any doctor should offer his community.

The injured person must be placed supine on a comfortable table immediately upon arrival, regardless of the slowness of the injury. Repair of wounds and painful dressings must not be done with the

patient sitting upright. Aromatic spirits of ammonia and whiskey are useful in avoiding an attack of syncope.

Cover the wound with a sterile dressing large enough to overlap the uninjured skin 1 to 2 cm. Make firm pressure with the fingers of the left hand to control bleeding. Wash the remainder of the face or scalp and hair free of blood with a wet towel; the wetter the towel the easier the blood is removed. Raise the sterile dressing, beginning at one angle of the wound, clamping bleeding vessels as they

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appear. Lift up the edges of wound and make a careful inspection of the depths, removing clots with smooth dressing forceps or by irrigating with saline, sterile water or weak peroxide solution. The author favors irrigating with weak peroxide solution because it makes foreign materials more easily identified and fracture line stand out clearly. Frequently the scalp has been stripped up for several centimeters, secreting various amounts of foreign material.

The mechanical cleansing of the wound is far more important than the liberal and blind use of antiseptic solutions. The relative merits of iodine, mercurochrome, aniline dyes, hypochlorite solution, ether, benzene, and picric acid as bactericides depend upon the care with which the wound has been mechanically cleansed and not upon their relative antiseptic qualities. The wound after inspection and removal of foreign material is flooded with any of the antiseptic solutions, iodine 3 to 7.5 per cent being the most frequently used. If any vessels continue to bleed, fine catgut ligatures are used, and if vessels have retracted and cannot be controlled with clamp, it may be necessary to use ligatures mounted on needles traversing the region of the vessels and tied just tight enough to control bleeding and not strangling all tissues in the grasp of the suture.

Now we are ready for suturing. Fine silk gut, black silk, horse hair, or Michel clips may be used. Michel clips are of very little use in the dense scalp but most useful in the frontal region and wounds of the upper face. If the wound is irregular, the angles are approximated first, the suture taking in the entire thickness of the skin. The deep fibrous layer is the layer that presents future spreading of the scar. One suture to 2.5 cm. is sufficient in the hairy scalp. In the face, sutures must approximate the skin accurately. It is a very sane procedure to drain all scalp wounds with small pieces of rubber band or twisted silkworm gut. Wounds of the face, if irregular or pocketed, should also be drained. All drains to be removed at

the end of twenty-four to forty-eight hours if infection has not developed. An excellent dressing is compresses of equal parts of glycerine and alcohol. The compress is covered with oil silk, gutta-percha tissue, silkoid, or oil paper. Drainage is promoted and crusting impounding exudate is prevented. Wounds must be dressed daily until you are sure infection is not present.

An immunizing injection of tetanus antitoxin is given in all lacerated wounds where the subcutaneous tissues are invaded. The extent of the wounds is no indication of the likelihood of tetanus bacillus contamination. A small wound may harbor tetanus bacilli. Lacerated wounds ground full of street filth should not be sutured but drained and allowed to heal by granulation.

Hair washed with equal parts of ether and benzene is sterile and shaving need not be done in the scalp or eyebrows unless the hair interferes with approximation. One must always remember no matter how slight the scalp injury may have been and even though there is no apparent intracranial injury, that a fissure fracture of the skull across one of the meningeal arteries may exist and spell future disaster if not carefully watched.

Wounds of the scalp and face heal rapidly, and infection is not likely to occur, because of the abundant blood supply. In wounds of the cheek or lips entering the mouth, the sutures should include the skin muscles and submucous down to, but not including the mucous membrane. Approximate the mucous membrane with fine silk sutures. If the Stenson's duct is cut across suture the skin carefully, do not close the mucous membrane in the region of the duct, thus allowing a fistula to develop into the mouth and not externally on the cheek.

Too much foreign material, glass, splinters, metal, paint and enamel, is closed up in wounds of the scalp and face. Careful hemostasis, followed by careful inspection and mechanical cleansing is the only way to avoid this inexcusable error.

# TREATMENT OF GRANULATING WOUNDS WITH DELAYED HEALING\*

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THE stages of repair in a wound which heals by granulation tissue are as follows:

1. An abundant exudation of small round cells, whose function is to remove dead or damaged tissues, and also to break up, disintegrate, and finally absorb any blood clot.

2. The invasion of the wounded area by fibroblasts from the tissues composing the parts.

3. Vascularization by protoplasmic buds growing out from the capillaries. These soon become canalized and lined with endothelial cells. The capillary loops thus formed give the granular appearance to the developing tissue.

4. Cicatrization and epithelization: In this stage the fibroblasts become spindle-shaped with collagenous material around them. This gives to the wound contractile properties which tend to make the wound smaller and also lift the underlying tissues toward the surface, making the wound less in depth. This property of contraction also acts to constrict the vessels in the granulation tissue, causing, them to disappear. When the entire surface is covered with epithelium the wound may be considered as healed.

There are numerous conditions under which granulation tissue grows, which may alter the character of the granulations to such an extent that the wound will not heal. Some of the more common of these conditions are:

1. Lack of rest in the part affected. Rest is an essential factor in the treatment of granulating wounds, and if the tissues are constantly being stretched it is quite often impossible to heal them. For example, granulating areas over extensor and flexor surfaces of joints are most difficult to heal if the part is not immobilized.

2. Irritation by rough, unsuitable dressings, or irritating chemical agents which may be used in the dressing.

3. Unhealthy or devitalized condition of patient's tissues, as in badly bruised or lacerated skin, or in locations where there is persistent venous congestion, which prevents access of healthy blood. An example of the latter is well demonstrated by varicose ulcers.

4. Constitutional disease, such as Bright's disease, diabetes, syphilis, scurvy or alcoholism, severe anemia.

5. Infection.

6. Foreign bodies.

The treatment of wounds which will not heal due to the formation of granulation tissue is:

1. Constitutional: in which any severe constitutional disease is sought for and treated accordingly. In diabetes, for example, diet and the proper administration of insulin are used.

2. Local:

(a) Application of medicinal agents which may cut down excessive growth of granulations, or may stimulate inactive growth or clear up a low-grade infection.

(b) Surgical: Where a cicatrizing base of a granulating area is preventing it from healing, excision may be done and the freshened edges loosened and brought together, or skin grafting done as indicated. In cases of venous congestion due to varicose veins the latter may be excised, or treated by the injection method, i.e., injection of the veins.

First of all in granulating wounds which do not heal, constitutional diseases should be ruled out, but if found should be properly treated.

Next, one often encounters an exuberant overgrowth of normal pink granulations which have grown so far above the surface

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of the adjacent skin levels that it is impossible for epithelium to grow over the granulating bed. In these cases, repeated "burning down" to skin level by the application of silver nitrate caustic stick at intervals as indicated, will usually suffice to cause a rapid epithelialization of a wound. Not infrequently the granulating bed may present healthy granulations but be of such a diameter that it is quite impossible for the epithelium to push across the space. In these cases pulling the edges of the wound into closer proximity by adhesive strips is often sufficient. Another very excellent use of adhesive in this type of wound is placing  $\frac{1}{4}$  inch strips of sterile adhesive around the edges of the wound extending out into the granulating bed from the skin edge. In twenty-four hour's time the advance of epithelium under the strips can be recognized by the naked eye and by a continuation of the same process often very large granulating areas are covered over by new skin.

An example of excessive overgrowth of healthy granulations is well illustrated by a patient who had a scalp wound which would not heal, following a fracture of the skull. When I saw her several months later there was a mass of granulations tissue piled high so that it resembled a medium-size mulberry as to size and appearance. As it was clipped off with scissors a small sized artery was found extending up into it. Following the removal of this mound of granulation tissue, the healing-over process took place rapidly.

A chronic low grade infection may cause an exuberant growth of unhealthy granulation tissue. The granulations then take on a paler or grayish appearance which heap up and overhang the skin edges. There is usually a considerable whitish purulent discharge and the wound refuses to heal. This type of granulation is best treated by wet dressings until the infection is overcome, followed by use of the caustic stick, together with some mildly disinfecting and stimulating agent, such as balsam of Peru, dichloramine T, mercurochrome ointment, etc.

Foreign bodies in a wound, such as an unremoved suture, spicule of dead bone, a small piece of gauze or rubber drain, or in hand infections a piece of dead tendon, will cause an overgrowth of grayish, unhealthy appearing granulation tissue. Prompt healing follows removal of the foreign substance.

In contradistinction to exuberant granulations, there are the underdeveloped or insufficient granulations. Provided constitutional disease has been ruled out, this type of granulation tissue needs stimulating. Balsam of Peru is probably foremost among the non-irritating stimulants. There are numerous others, such as dichloramine T, Durante's solution, etc.

Physical agents are also useful. The simple therapeutic lamp consisting of a heat-giving bulb applied for fifteen minutes three times daily is most efficacious in promoting growth of sluggish granulations. Other light therapy such as the infra-red, or ultraviolet lights are useful but should be used with extreme caution and by an experienced person.

Heliotherapy, which is cheapest and most often accessible, is oftentimes completely forgotten. Subnormal granulation tissue when exposed to the direct rays of the sun is always benefited by the exposure, and healing is hastened. The patient can do this frequently at home between visits to the doctor. It must be impressed upon the patient, however, that the exposure should be direct and not through a window pane.

Constricting by voluminous dressings should be avoided, the aim should be to give as free an access of air to the granulating area as is compatible with good wound asepsis.

Under the class of deficient granulation tissue as a cause of wounds not healing, probably the foremost offender is the varicose vein ulcers in the lower extremities. Due to the constant venous congestion these ulcers at times will actually spread instead of healing. The most efficient non-operative method in this type of case is the application of the so called

ACE (all cotton elastic) bandage. This is applied in the morning before the patient gets out of bed, and is worn all day. Many of the smaller sized ulcers of this type will heal quickly under this treatment. Elastic stockings should never be used as they constrict at the top and the bottom, adding to the venous congestion rather than relieving it. They also can be extremely uncomfortable. For the larger, long-standing, more callous ulcers with cicatrized base, surgical removal of the veins is indicated, or better still, the injection method which is fast displacing the surgical procedure.

Wounds caused by chemical burns, severe bruises, etc., which cause a deep loss of tissue and heavy "scab" formation,

are best treated by wet dressings of saline until the slough comes away.

Among the mildly stimulating ointments for this group of sluggish wounds is 5 per cent ammoniated mercury, boric acid and zinc oxide ointments.

In conclusion it may be said that wounds which will not heal, due to the formation of granulation tissue, fall into two great classes, the overgrowing granulations and the deficiently growing granulations. In the first group a cutting-down of the overgrowth or removal of the cause of this overgrowth is indicated. In the second great group the granulations must be stimulated and encouraged by the application of the physical and physiological principles indicated.



## THE RÔLE OF LOCAL ANESTHESIA IN OFFICE PRACTICE\*

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CONSIDERED from the standpoint of anesthesia alone, the office equipment of different physicians varies widely. Obviously what might apply to one would have no application to others. Few physicians realize the ease with which any office may be equipped with the necessary paraphernalia required for the routine employment of local anesthesia. Once the equipment is installed and the fundamentals of technic mastered, the bugaboo that the use of local anesthesia is a complicated process fades into obscurity. Furthermore, when the physician has his office so equipped and realizes the advantages that may accrue from the routine use of local anesthesia in office practice, he will be surprised at its many advantages and, as a rule, wonder how he formerly carried on without this important adjunct.

Regardless of the type of work a physi-

cian does, general practice or specialization, rural or urban, there is one fundamental principle that should always be his guide. The interests of the patient should transcend all others. Even the application of the slogan "the greatest good to the greatest number" must never be allowed to interfere with the application of this principle. Every individual patient should receive the benefits to be derived from following this maxim. Time, expedience, decreased income, the physician's comfort and every conceivable factor must be considered secondary in importance to the patient's interests.

*Advantages.* With the above considerations in mind there are many advantages to be gained by the employment of local anesthesia whenever it is indicated. Incidentally, its use corresponds in a marked degree with the patient's interests, expedience and many other important points.

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From the patient's point of view, there is usually a great difference between a visit to the hospital and the office. In the absence of an emergency this difference is often sufficient to cause the patient to delay or avoid treatment rather than go to the hospital. It is my experience that many patients who will not consider entering the hospital will consent to a minor operation in the office. Thus, the fact that the physician is prepared to perform minor surgical procedures at the office will, in many instances, bring elective minor surgical cases to operative treatment which otherwise might not come at all. The association of the hospital in the minds of the laity with confinement to bed and expense contrasts markedly with a trip to the physician's office and an ambulatory convalescence.

Again, there is a large borderline class of cases which, depending upon the choice of the physician, may receive treatment at either hospital or office. Most people, however, prefer the latter. The advantage of local anesthesia may manifest itself in another way. Those with known surgical conditions, as minor skin or rectal lesions, may present *earlier*, provided they believe that they can be treated at the office. Indeed some of these, if confronted with a trip to the hospital as the only alternative will refuse succor. Nor infrequently those who, for the reasons mentioned, go to the office, may be prevailed upon to go to the hospital for an operation should it be deemed necessary, whereas had they not expected that they could be treated at the office, they might not have presented at all.

Another advantage of the constant and proper use of local anesthesia in office practice is its aid in making painless examinations, or instrumentations, especially those associated with the bladder or urethra. In regard to this point, it has been my observation that few physicians would think of inflicting upon a patient an examination, or any kind of instrumentation, that would result in loss of consciousness, but even in this epoch,

some physicians still insist upon passing urethral sounds in the male without first anesthetizing the urethra, with the result that an occasional patient faints on account of the pain. The pathological rectum or anus, when acutely inflamed, is likewise all too often examined without anesthesia, the patient being caused needless torture. It is obvious that the more attention there is paid to the use of local anesthesia in office practice, the less will be the suffering of the sick and the more incentive there will be for patients to attend to their ailments.

*Equipment.* The equipment required for employing local anesthesia in office practice is simple and yet, if the physician expects to meet the indications and he and his patients are to derive the full benefits of the method, careful thought must be given to the armamentarium.

Off-hand, one might think that a syringe, some needles and an anesthetic solution are all that are required in order to employ local anesthesia in office practice. As a matter of fact, these essentials are but a portion of the necessary equipment and the choice, preparation and care of these is exceedingly important. Provided one wishes to obtain the maximum advantage of local anesthesia, attention must be given to the adjuncts its use demands at the office as well as the hospital.

The psychic aspect of the subject must not be overlooked and while preliminary hypodermic medication is seldom indicated or advisable in office practice, everything possible should be done before and during the examination or operation, to allay the patient's apprehension and insure comfort and confidence.

A most important dictum is that no patient should be given novocaine by injection while in the upright position, provided the drug can be administered with the patient reclining. Also if the drug is injected with the patient in the upright position, facilities should be at hand to allow the assumption of the prone position without the slightest delay. So-called

idiosyncrasies to novocaine, while extremely rare, probably do exist and as patients not infrequently faint from other causes, which produce cerebral anemia, the treatment of both conditions demands the prone or inverted position.

In our experience, ether is the most satisfactory antidote to novocaine. Caffeine is recommended but the few slight reactions we have seen subsided before this drug could be administered. It is our opinion that ether should be at hand and administered at once in case a patient shows a serious reaction. Caffeine, when used, should be given intravenously and in a large dose: 7 grains. These drugs are as much a part of the necessary equipment as are syringes and should be in readiness before the local anesthetic is administered. Slight reactions require only the head-down positions for a few moments. It is probable that the majority of these reactions are due to cerebral anemia and have no relation to the toxicity of novocaine. A few inhalations of ether are stimulating in any case and do no harm.

**Sterilization.** The sterilizing basin should be square and may be used as an instrument tray during the operation. At least two good syringes, preferably of different sizes, (5 and 10 c.c.), should be prepared by boiling in distilled water. A number of needles, in sizes corresponding to the demands of the case in hand, should be sterilized with the syringes. Two small containers of glass or metal and graduated in cubic centimeters should also be sterilized. The drugs required may be sterilized with the syringes and instruments, being placed in one of the containers which is partially filled with water. Corresponding to the amount of solution required, a number of Ringer's tablets are dropped into the solution before boiling. With one of the syringes a sufficient amount of water may be added after sterilization to bring the solution to the proper level. Epinephrine tablets, if used, may be added before sterilization, but if adrenalin chloride is used it should be added to the solu-

tion *after* sterilization by means of a sterile medicine dropper. This procedure may be considered safe as repeated bacteriological tests have been found negative. A more simple method is to keep on hand a "stock solution" of novocaine in Ringer's solution (2 to 4 per cent) in a sterile bottle and dilute it as desired. Such solution may be kept from four to six weeks, and probably much longer, without deteriorating although it may take on a light brownish color. Solutions that are dark brown should not be employed. Careful cleaning of the syringes and needles after using is important. The needles should be flushed with alcohol or ether, then with air and the lumen coated with a thin oil.

Quinin and urea hydrochloride in a strength of 1:600 should be used in all granulating wounds as a prophylactic against pain. Its preparation is similar to that of novocaine.

Anesthesin should be employed preliminary to all throat operations, one tablet being dissolved in the mouth thirty, twenty and ten minutes before operation. A novocaine suppository (4 per cent) should be inserted in the rectum one-half hour before making a proctoscopic examination. In case the necessity of an operation is apparent, the rectal examination should be postponed until after anesthesia has been established by a sacral block or by infiltration. By following this plan much suffering may be avoided.

Brachial anesthesia may be employed at the office and under its influence emergency or elective operations upon the upper extremity may be performed. Even dislocations of the shoulder and elbow may be reduced under this type of anesthesia.

For the passage of a catheter or sound the instillation of 4 per cent novocaine solution, to be retained for a period of fifteen to twenty minutes, is satisfactory except in the case of complicated strictures, which are best treated at the hospital and under sacral anesthesia.

Cystoscopic examinations may be made routinely at the office but this requires

special equipment, x-rays, etc. and should not be attempted in the absence of complete equipment. Furthermore except in "repeaters," sacral anesthesia is the method of choice for cystoscopy and few offices are properly equipped for the induction of this type of anesthesia. Therefore, unless the equipment is adequate and a well-trained corps of assistants available, sacral anesthesia should be reserved exclusively for hospital practice.

All types of minor surgery may be performed at the office under local anesthesia. The difficulty of maintaining asepsis is a more important reason for sending patients to the hospital than is the difficulty of administering satisfactory local anesthesia.

In an office equipped with x-rays, fractures, with the possible exception of those of the lower extremity, may be reduced under local anesthesia. In the upper extremity brachial anesthesia, conduction anesthesia, or a transverse infiltration block are entirely satisfactory and the patient may become ambulatory in about two hours. In such cases, anesthesia may be established, the physician may go on with his other work for fifteen or twenty minutes, while the anesthetic solution is disseminating, and then reduce the fracture. A qualified nurse should be in charge of the patient the while. Anesthesia will endure sufficiently long to permit the repeated making of roentgenograms.

The properly equipped office therefore compares favorably with the hospital for this type of work, whereas, with general anesthesia this is not true. Among the other conditions that can be treated under local anesthesia are: Many varieties of lacerated wounds, skin tumors, the removal of foreign bodies such as needles from the tissues, the removal of foreign bodies from the eye, the injection of the sciatic nerve with quinine and urea (in these cases the patient may ride home and remain quiet for a day or two).

The physician who handles a considerable amount of industrial surgery will find it well worth-while so to equip his

office that a wide variety of wounds, muscle and tendon suture, amputations and plastics about the hands may be done under local anesthesia. I may say that we have carried out all of these procedures at the office under local anesthesia but, I repeat, careful preparation for all anesthetic emergencies was made. Therefore, as stated, he who essays to do this type of work must make adequate preparation for it. The outlay is not great but everything should be in readiness to meet the requirements. Once a system is established, it soon becomes routine and the physician who prepares his office for this routine will be surprised at the scope to which local anesthesia can be employed in office practice and likewise astonished at the satisfaction that will be experienced, not only by him but his patients as well.

The anesthesia technic in office practice differs in no wise from that used in hospital practice. The same attention to *finesse* is required in both. Borderline cases, when it is practicable, should be sent to the hospital.

Regardless of what may be the relative merits of local and general anesthesia in hospital practice, local possesses many advantages over general as an office anesthetic. Thus the general practitioner, who may be situated far from hospital facilities and a good anesthetist, may increase his usefulness and the scope of his activities, by familiarizing himself with local anesthesia technic and equipping his office for its employment. Likewise the surgeon or surgical specialist may offer to his patients many of the advantages mentioned above and if fortified with an assistant, an office nurse and x-rays, may perform cystoscopies, tonsillectomies, reduce fractures, treat surgical lesions of the skin and rectum and a variety of industrial injuries.

#### SUMMARY

The scope of local anesthesia in office practice may be made comparatively broad. Its use has advantages that are both economic and psychic. It is of special



advantage to the isolated practitioner of medicine who lacks hospital facilities. Its use demands special training and equipment and no one who is not prepared to employ it skilfully should essay its use.

With proper training and equipment local anesthesia may be employed in office practice with a great deal of satisfaction to the physician, surgical specialist and their clientele.



## THE PREVENTION OF CICATRICAL CONTRACTIONS\*

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THE degree and extent of cicatrix formations depend upon a number of known factors and an unknown number of less apparent ones. Thus, in a consideration of cutaneous burns, the surface area involved and the depth of the tissue injury will govern the *extent* of the subsequent scarring. Wound infection plays an important part in repair processes and influences to a large extent the *degree* of scar tissue formation. Clean wounds heal with minimum scarring. The converse is likewise true. In addition, clinical experience indicates that certain microorganisms produce more tissue destruction than others, thus influencing the extent of the subsequent cicatrix. The anerobic bacteria are peculiarly the offenders in this respect.

Less apparent factors must surely be operative in determining the degree and extent of scar tissue formations. It is difficult to explain why some patients produce large scars with cicatricial contraction resulting in deformities, while others, with practically the same wounds, will show little tendency to scarring and no indication of deformity. The reasons for this marked difference in individual response are not known, but will probably be found in the future through further studies in tissue physiology and tissue chemistry. From a preventive standpoint, likewise, little is known which would aid in forestalling the development of

extensive cicatrices in patients who, from previous experiences, are known to be susceptible to this tendency.

The anatomical site of the original wound or injury governs the development of a cicatrix which will contract so as to produce deformity or interference with function. Extensive wounds, especially burns, involving the neck, lips, angles of the mouth, eyelids, the axillary folds, the popliteal regions, the antecubital fossae and the fingers, will very often result in serious deformities, unless measures are taken to prevent such sequelae. Even then the outcome may not be a happy one. In considering the healing response of the various regions of the body enumerated, certain axioms, more or less true, may be enumerated. Second and third degree burns involving the eyelids will produce cicatricial contractions resulting usually in ectropion of one or both eyelids. Extensive injuries or burns about the mouth and lips will often cause bizarre cicatrices changing the entire facial expression, interfering with the functions of the lips or producing ectropion of the lips. In the latter condition, the constant drooling of saliva is a particularly distressing complication. Deep burns of the neck during the process of cicatrization produce a very disfiguring deformity whereby the chin is drawn down toward the chest and extension and rotary movements of the head are greatly impaired. Burns involving the

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axillary folds form cicatrices which bind the arm to the side of the chest and prevent abduction at the shoulder, a serious functional disability. The flexor surfaces of the various joints of the extremities are especially vulnerable from the standpoint of cicatricial contractions and the subsequent development of flexion contractures.

In considering the prevention of cicatricial contractions, the surgeon must consider the effect on form and function of the wound he is about to make with his scalpel. This is especially important in the surgery of the face, neck, axillae and extremities. The surgeon should be familiar with the anatomy of the "lines of the skin." These "lines" indicate where skin tension is greatest, where relaxation occurs, where natural cutaneous wrinkling is situated and serve as a guide to the proper placing of incisions, their direction and extent, with a view to producing minimum subsequent scarring. For instance, a median vertical incision in the neck should rarely be made. The tendency toward a flexion contracture is considerable. Again, one should never make an incision at right angles to the flexion creases of the joints of the extremities, especially of the fingers. This might very well be considered one of the ten commandments of surgery. An incision made over the front of a finger so as to cross the flexion creases at right angles will nearly always produce a flexion contracture. The proper site for a finger incision is on the anterolateral aspect. For greater exposure of the deeper structures, it may have a right-angled extension running parallel with a flexion crease.

In dealing with injuries and wounds of the regions of the body already enumerated, the surgeon must constantly bear in mind what effect the subsequent scarring will have on form, and especially, function. In wounds of the extremities, measures must be taken to prevent contractures of the flexor surface of joints. The judicious use of splints or of the principle of traction and suspension during the process of healing ranks foremost. Thus, a knee should be

kept in extension during the healing of a burn in the popliteal space. The head should be kept in extension during the convalescence following a burn of the neck. Burns or wounds with loss of skin involving the axillae call for wide, full abduction at the shoulder until healing is complete. The surgeon should be particularly solicitous of wounds of the flexor surfaces of the fingers because of the ease and rapidity of the development of contractures. Intermittent splintage in extension is the method of choice. I say "intermittent" advisedly, because finger joints become stiffened easily with continued immobilization. Or, one may make use of the principle of elastic traction by the employment of a banjo splint with rubberband traction of each finger. This permits of continuous extension.

Often the surgeon is confronted with a large granulating wound, following a burn, for instance, which presents a constantly weeping surface and which promises a prolonged convalescence. During the process of epithelialization of such a wound by the growth of epithelium from the sides, considerable fibrosis of the underlying tissues takes place and the chances for cicatricial contraction are greatly enhanced. The early application of Thiersch grafts to such a wound as soon as the appearance and bacteriology of the granulations permit, brings about early healing and, what is more important, a minimum of the underlying fibrosis. Very often, indeed, with the parts placed in over-corrected positions, no contraction of the scar will occur. Should contraction develop, however, the procedure has accomplished a considerably shortened convalescence with rapid healing. The more general adoption of this procedure emphasized by H. H. M. Lyle, is recommended as one of the important aids in the prevention of cicatricial contractions. The subsequent application of pedicled skin flaps or the performance of various plastic operations must be considered for the relief of scar contractions, should they occur.

# OFFICE TECHNIC OF CERVICAL BIOPSY\*

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THE early diagnosis of malignant neoplasms is the most important item at the present time, and nowhere is this necessity greater than in the cervix uteri. When one considers that over 50 per cent mortality still persists with the most modern therapeutic measures used, and that carcinoma of the cervix is the most common of all malignant tumors in women, there appears only one way to combat this deplorable situation, and that is by recognition of the process in the early stages, depending not only on our diagnostic acumen, but also looking to the microscope for aid. This necessitates doing more frequent biopsy studies of suspicious lesions.

Erosions of the cervix are by no means as innocent and unimportant as they look, for they not only frequently serve as a starting point for a carcinoma, but may also present, to all intensive purposes, a benign-looking lesion behind which an early carcinoma is gaining a fatal headway. So too, the small pedunculated polyp, protruding through the external os of the cervix, may be and not infrequently is the seat of an early myosarcomata of the cervix.

Bearing these two possibilities in mind when examination of the cervix presents such a condition, this examination is not complete until a biopsy has been done, and this simple procedure can be safely and aseptically done in the office.

The procedure is as follows: With the patient in the knee-chest position and using a Sim's vaginal speculum which elicits the best exposure of the cervix, though good exposure can be obtained with the patient in the lithotomy position, and a bivalve speculum in place, the vagina and cervix are gently swabbed with cotton until dry; the cervix and upper third of

the vagina are painted with 3½ per cent tincture of iodine. Into the cervical polyp, or into the suspicious zone of cervix a single hook tenaculum is inserted to steady the cervix or polyp and afford the operator a point of leverage. In the case of a polyp it is advisable to be very gentle in the traction so as not to tear the polyp off its attachment because of the danger of hemorrhage, but to use a moderate amount of tension and then with a cautery tip at a cherry-red heat slowly transect the pedicle until the polyp has been severed. The heat from the cautery safeguards against hemorrhage by coagulating the blood vessels cut across.

In the case of the cervical lesion, into which a tenaculum has been inserted, using a sharp knife, a small wedge of tissue is removed about 1 cm. on each side. Then gently sponge the bleeding surfaces dry and cauterize the raw areas with the cautery tip at a cherry-red heat until all bleeding has ceased. Following both procedures a tampon soaked with 4 per cent mercurochrome is placed flush against the cervix. The tampon is left in situ for at least twelve hours, serving two purposes, i.e. as an antiseptic, and to aid in hemostasis if the cauterization has been inadequate.

The specimen should be immediately placed in a test tube containing 10 per cent formalin and dispensed to a competent pathologist for microscopic study.

In conclusion one must remember that:

1. Gentleness with tissues suspected of being malignant cannot be too strongly emphasized, for trauma in any form favors metastases.

2. All instruments must be sterile.

3. The knife must be both thin and sharp to minimize the trauma.

4. The cautery at a cherry-red heat is used to seal off all lymphatic and blood

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vessels which are cut across, thus preventing metastases and also eliminating the possibility of an open, free wound from becoming infected; for infection runs hand in hand with trauma in the spread of this disease.



## THE BUBO\*

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CONTRARY to general belief that a bubo is an inflammatory reaction of the inguinal glands, any lymphatic gland which is undergoing inflammatory changes is a bubo. The etiology of the inflammatory reactions is, of course, multitudinous and presents a most difficult and at times, baffling diagnostic problem. It is not so much a question of the treatment of the lesion, which we will soon consider at greater length, as it is of differential diagnosis. At times the diagnosis can not be made and the lesion is consigned to the waste-basket or "granulomas."

A patient comes to the office complaining of a "lump" in the groin. It is hard, firm, and painless or it is red, inflamed, painful and tender. Or the enlarged gland may be found during the course of the physical examination, apparently symptomless. Another patient comes in presenting a ragged ulcerating lesion in the groin, perhaps painful usually necrotic, secondarily infected, and discharging purulent material. Effective treatment can be instituted only after a diagnosis is made.

The buboes resulting from tropical sore, bubonic plague, oriental plague, actinomycosis, glanders etc. are so rare that they need not be discussed in a paper of this nature. The common garden variety of bubo claims our attention first and perhaps the most common of all is the bubo consequent on gonorrheal or chancroidal infection.

The swelling of the inguinal glands during the course of gonorrheal infection

may come on shortly after the onset of infection or some years afterward. Usually a focus of infection still remains in the seminal vesicles, prostate or epididymis which feeds the infective material into the lymphatics. The first appearance of the bubo is heralded by a small somewhat tender swelling in the inguinal region. The swelling increases in size, the pain becomes more intense and the skin over the glands is tense, red, edematous and excruciatingly tender. The glands are very hard at first but after a time necrosis begins and suppuration which is frequently followed by rupture through the skin ensues. Thick, creamy, greenish pus is found on incision of the mass. After the glands have softened the pain is relieved and incision and drainage is soon followed by rapid granulation. The gonococcus is not found in the tissue and the inflammation, in the majority of cases, is due to absorption of toxins rather than the presence of the specific organism. Usually the patient has an acute gonorrhea when he presents himself and the diagnosis is self-evident but a careful rectal examination should always be made to rule out the prostate and seminal vesicles as possible foci of infection.

The treatment is the essence of simplicity: The patient is put at rest and heat, is applied in the form of hot wet dressings, hot baths and hot-water bottles. If absorption is going to take place the heat will hurry it along and if the glands are going to suppurate the heat will localize the pus. If the glands become soft and fluctu-

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ant with this treatment, incise and drain, do not wait for rupture.

The so-called "iodine compress" is very useful in the early stages of a bubo, and will either abort its progress or hasten it on to resolution. The iodine compress is as follows: Paint the affected area with tincture of iodine, place over this a gauze pad saturated with glycerine, then cover this with a piece of oil silk or gutta percha and hold in place by a spica bandage. This compress can be changed daily.

Perhaps the next most common bubo is the satellite bubo of chancre. The inguinal glands in syphilis appear shortly after the appearance of the chancre. The glands insinuate themselves in a slow painless fashion and become enlarged and firm. Contrary to general opinion the glands are quite tender and painful when they have attained a moderately large size.

The presence of the chancre, the history of exposure, the Wassermann reaction, the clinical appearance of the genital lesion and the demonstration of the spirochetes in the penile sore make the diagnosis. The microorganism may also be found in the bubo in many cases with proper staining and occasionally can be found on dark-field examination of material aspirated from the swollen gland. Only rarely do the buboes rupture through the skin, and with the institution of proper antiluetic treatment they soon subside and melt away: The gumma of tertiary syphilis is also a common offender. This lesion will frequently rupture through the skin and present a sloughing, necrotic cavity which heals slowly if at all. The dark-field is usually negative but the history and the Wassermann reaction should help in making the diagnosis.

The chancroid or soft chancre, as it is frequently called, is most common among the negroes. The primary sore is usually on the penis. This appears in twenty-four to forty-eight hours after exposure and is caused by the streptobacillus described by Ducrey. The ulcerations are ragged and undermined and the floor of

the ulcer is usually covered with necrotic material which soon becomes secondarily infected. Almost always the inguinal lymph glands are involved. They become greatly swollen and tender and occasionally they rupture through the skin but more often incision reveals a quantity of thin purulent material. The glands are matted together and the process advances through the lymphatics to the whole chain. Pain is the outstanding symptom and appears early, becoming progressively worse. Healing takes place with extensive scar formation. The disease is autoinoculative and this serves as an aid in the differential diagnosis. If a small area of healthy skin on the thigh is vaccinated with a little of the material from the lesion, the appearance of a pustule in twenty-four to forty-eight hours indicates that the original lesion is a chancroid.

Treatment consists in wide incision and drainage of all infected and suppurating areas, hot wet dressings of boric acid or bichloride of mercury 1:10,000, hot baths, and the application of copper sulphate or Rosenwald's solution two or three times a day (Copper sulphate and Rosenwald's solution must be applied topically and not in the form of a wet dressing). Convalescence is usually long and tedious. Often gonorrhea and chancre are complicating factors. If this be true treatment for these conditions should be started immediately. A severe balanoposthitis or a phimosis may require dorsal slit or bilateral slit.

Granuloma inguinale is not primarily a lesion of the lymph nodes. The disease usually manifests itself first on the penis or scrotum and later the lesion may appear in the groin. The glands are not involved unless secondary infection supersedes. Diagnosis is made by inspection and microscopic examination of a bit of the tissue from the base of the ulcer. Treatment with tartar emetic gives the best results.

Tuberculosis of the inguinal nodes is not a common finding but occasionally it is seen, usually associated with tuberculosis elsewhere in the body. The glands may be

enormously enlarged and present the characteristics of an ordinary intense inflammatory process. They may rupture through the skin and form chronic draining sinuses. Except in the early stages of congestion and inflammation there is very little pain although they may be tender. During the acute stage the pain may be excruciating.

Sunshine, ultraviolet light, and the usual hygienic treatment of any tuberculous lesion should be instituted. The condition may run a very protracted course and occasionally total excision is attempted with variable results.

All too often the simpler affections of

the genital regions produce an inguinal adenitis whose underlying cause may be overlooked. Pediculosis pubis frequently produces a bubo and so also may the various non-specific infections of the penis and scrotum. This should always be kept in mind and treatment of the underlying cause be instituted. Lesions on the toes, feet and leg have also produced buboes.

As a final thought we must remember that the enlarged inguinal glands may be only a part of a systemic disease and that they may be affected in Hodgkin's disease, primary and secondary malignancies, and in the various forms of so-called blood diseases.



## MINOR SURGERY OF THE ANORECTAL REGION\*

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WHILE it is desirable in most cases requiring any type of surgery to have the patient in a well-equipped hospital and made to rest after the operation, there are many anorectal conditions which can be surgically treated, if necessary, in office practice and the patient not be confined to bed.

Practically every case of anal fissure, hypertrophic papillitis, anal cryptitis, single polyp, external thrombotic hemorrhoids and prolapsing internal hemorrhoids of moderate size, as well as simple direct anal fistulae and small abscesses may be treated in office practice with a large degree of success.

In a few patients, even in this day of a wider dissemination of medical and surgical knowledge among the laity, there still exists an antipathy against the hospital and an inordinate fear of surgical operations and general anesthesia.

There is a class of patients which would unquestionably fall into the hands of the irregular, the charlatan and the unethical fellow who guarantees cures, if

the regular profession did not have some non-confining method of treatment which would successfully relieve the patient of many anorectal pathologic conditions without hospitalization.

It is not my purpose to discuss the treatment of all of the diseases which could be so treated nor the various methods of treatment for any single disease in a brief article of this type. Only methods which have been successful in my hands for the treatment of such anorectal conditions as can be safely treated by the average physician in office practice will be discussed.

### HEMORRHOIDS, ACUTE, THROMBOTIC

Most patients suffering from thrombotic hemorrhoids, single or multiple, can be treated in office practice. With the patient in the left lateral position on the operating table a bluish or purplish mass is noted at the anal margin. Its skin covering is stretched as a rule and the patient has usually irritated it by attempting to push it into the rectum, where it did not belong.

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After cleansing the part with alcohol and painting it with 4 per cent mercuriochrome solution, the tissues underneath, above and surrounding each hemorrhoidal mass are injected with a  $\frac{1}{2}$  per cent novocaine or apothesine solution. The external hemorrhoid is then grasped with a forcep and through an elliptical wound the clot or clots evacuated. Rarely is there any arterial bleeding. If so, the spurter should be ligated with fine catgut. Some anesthesine powder is applied to the wound and a pressure gauze pad firmly strapped in place with adhesive plaster. The patient should rest three or four minutes in a recumbent position after the dressing is applied and then may go home to rest the balance of the day. He reports daily to the office for dressings until healed. He is instructed to take an ounce of mineral oil every night to prevent the formation of hard stools.

#### HEMORRHOIDS, INTERNAL, CHRONIC, PROLAPSING

In most cases internal hemorrhoids should be removed at one time when the patient can be confined to a hospital for at least two or three days. In office practice, however, internal hemorrhoids can be removed under infiltration anesthesia, one at a time and the patient need not lose any time from his vocation.

He is asked to report to the office after having had the bowel thoroughly cleansed by the administration of a soda bicarbonate enema the preceding night followed by another in the morning. One-half hour before his appointment for operation a grain of codeine is administered by mouth. He is put in the left lateral position and the skin surface prepared as already discussed. The anesthesia of choice is a 0.5 per cent solution of novocaine or apothesine for the preliminary injection and a 0.5 per cent solution of quinine-urea hydrochloride for postoperative anesthesia. A 20 c.c. glass syringe armed with a 2 inch 20 gauge needle is filled with the solution of choice. The skin is punctured

$\frac{1}{2}$  inch behind the posterior commissure and a few drops of the anesthetic solution are immediately injected. Several cubic centimeters of the solution are then injected in a u-shaped direction on both sides of the anal canal, until the entire circumanal skin has been infiltrated from one puncture. Two or 3 c.c. are injected deep into the sphincter muscle in the posterior commissure and the needle withdrawn. Next the entire area surrounding the anus 1 inch from the external sphincter muscle is infiltrated with a 0.5 per cent solution of quinine-urea solution and five minutes allowed to elapse. At the end of this period the sphincter should be completely relaxed and the hemorrhoids prolapsed. Inasmuch as in practically all cases there are three hemorrhoidal groups present, namely: left lateral, right anterior and right posterior groups, each group must be removed at a different time. The interval is usually one week.

#### HEMORRHOIDS, EXTERNAL, CUTANEOUS

These consist of tags or pouches of thickened skin occasionally containing varicose veins. They usually bear a definite relation to internal hemorrhoidal tumors and really are not true hemorrhoids at all. Inasmuch as they are annoying to the patients, interfering with the proper toilet of the parts, they are often sources of annoyance and complaint. In office practice these should be removed singly. After the skin is cleansed and sterilized the selected tag should be distended with a 0.5 per cent novocaine solution and under its base a few drops of 0.5 per cent quinine-urea solution should be injected. The hemorrhoidal tag or fold should be excised level with the surrounding skin and always radial to the anal opening. The outer extremity of the wound should never be cupped or rounded, but should always taper to a point. This allows the wound edges to come together accurately and stitches are rarely necessary. Spurting vessels should be tied with small sized catgut but venous oozing is controlled

by a compression bandage. If these cutaneous tags are small it is not necessary to confine oneself to the removal of a single one. If there is no occasion for haste, it is better to remove them singly in office practice.

#### FISSURE AND ULCER

A fissure is a crack usually extending through the transitional membrane lining the anal canal down into the skin. If it has existed for several days the outer or skin extremity is often thrown into a thickened crescentic fold or tab designated as a sentinel pile. Fissures usually become ulcerated and are inclined to chronicity. They may occur anywhere in the anal circumference, but many are found in the posterior quadrant. They are traumatic in origin and most often result from tearing down of a posterior crypt by sneezing, coughing, straining or the passage of hard or irritating stools. They may be produced by faulty instrumentation. The sharp stinging or cutting, throbbing, spasmodic and often agonizing pain is out of all proportion to the size of the lesion and the patient demands prompt and lasting relief.

In order to overcome this sphincter spasm, the sphincter must be put to rest. Formerly it was deemed necessary to always divulse the sphincter to accomplish this. We now know that divulsion suspends sphincteric activity by forcible overstretching, tearing the sphincter fibers and oftentimes injuring the sphincteric nerves. We now know that sphincteric rest is best accomplished by putting at rest only the area of sphincter fibers involved at the site of the lesion. Occasionally sphincteric rest of a fresh fissure can be accomplished by the injection of a 1 c.c. of 2 per cent quinine-urea solution directly underneath it. After the skin is prepared a point  $\frac{1}{4}$  inch outside of the external extremity of the fissure is punctured and the entire fissure raised in a wheal produced by the injection of the quinine-urea solution. A temporary fibrous splint is

produced by the action of the quinine-urea solution in the tissues and this arc of the sphincteric circumference is given temporary physiologic rest. If a sentinel pile is present it is excised at the same time and in the same manner as already described. If the injection of quinine-urea solution does not give the patient more than temporary relief, the fissure should be incised. The sphincter should be anesthetized according to the technic already described and quinine-urea solution injected in the same manner, but the infiltration should completely surround the area involved. An incision should be made through the base of the fissure and through approximately one-fourth of the thickness of the sphincter. This incision will put these sphincter fibers at rest during the healing process. The skin edges should be incised so that there will be no overhang remaining and a trench-like wound is produced. The external part of the incision should be brought out on to the skin for at least  $\frac{1}{2}$  inch. Spurting vessels should be tied and a piece of rubber tissue inserted in the wound to remain for a few hours and a compression dressing applied.

#### PAPILLITIS AND CRYPTITIS

Annoying and often painful symptoms are caused by hypertrophied anal papillae as well as by ulceration, and infection of the anal crypts. Anal cryptitis is a very fertile source of focal infective symptoms and should always be reckoned with in every case where a focus of infection is sought.

Hypertrophic papillitis is easily recognized on digital examination. The papillae are enlarged, thickened and usually very pale in color. Often a tear at the base of a hypertrophied papilla gives rise to sphincter spasm and other symptoms usually associated with fissure or ulcer. Infected or ulcerated crypts are found at the base of or between hypertrophied papillae. They are usually sensitive to touch and through the anoscope look angry red in



color. Often pus is expressed from the mouths of the infected crypts.

Cryptitis and papillitis usually cause anal spasm. While this condition is usually associated with internal hemorrhoids, in many cases no hemorrhoids are present. The removal of papillae and draining of crypts is easily accomplished under local anesthesia. The canal is anesthetized in the same manner as has been described for the removal of internal hemorrhoids.

Each hypertrophied papilla in a given quadrant is grasped with a fine pointed hemostat and excised from without inward with fine curved sharp-pointed scissors. If a spurting vessel is encountered it is tied with No. 0 catgut. Sometimes hypertrophied papillae may be removed with a snare or excised and touched with the galvano-cautery. All diseased crypts should be made prominent by traction with a hook-shaped tractor and excised or incised as the individual crypt demands. Any overhanging edges should be trimmed away. The insertion of a small anal tampon covered with some anesthetic and germicidal ointment is of great assistance in making the patient comfortable after the operation. This is allowed to remain until after the patient's next bowel movement.

#### SIMPLE, DIRECT FISTULA AND SINUS

As a general rule all fistulae are best treated in the hospital. If, however, careful study by the injection of bismuth paste and stereoscopic radiography demonstrates the fistula to be of the simple direct shallow type and not undermining the sphincter it may be excised under infiltration anesthesia in the office.

A fistula not over  $1\frac{1}{2}$  inches in length and not involving the sphincter muscles may be excised in the following manner: The parts are well infiltrated by novocaine or apothesine solution, care being taken to carry the injection well underneath

as well as over and around the fistulous tract. Heated bismuth paste is then injected into the external opening and will emerge promptly from the internal opening. A soft annealed silver wire probe of a small enough gauge to enter the fistulous tract without any force is passed from the external opening. The internal extremity of the probe is grasped with a fine hemostat and brought outside of the anus and the two ends twisted together. This forms a tractor upon which the fistula is threaded. The fistula is then carefully excised while threaded on this tractor. One must be careful not to injure the sphincter and if any of its fibers are incised these incisions must be made at right angles to them. All overhanging skin must be trimmed back to at least half again the width of the wound. A piece of rubber tissue is inserted as a drain. It may be necessary in order to control oozing to use gauze for pressure. These wounds should never be packed.

The presence of gauze packing tends to stimulate the growth of fibrous tissue. This often means an overgrowth of fibrous tissue and consequent distortion of the parts. Many cases of sphincteric incontinence have been caused by gauze packing preventing the severed ends of the anal sphincters from reuniting.

No cases of anal fistula should be operated upon in office practice unless the patient is kept under constant observation until the wound is completely healed. Many a properly performed fistulectomy when followed by careless, negligent or improper after-care has resulted disastrously. Meticulous after-care is of the greatest importance in all cases of anorectal surgery. It is this careful attention to details which distinguishes the higher percentage of successful results following operations performed by proctologists compared with that done by the surgeon who only occasionally treats patients suffering from anorectal disease.

# TONSILLAR ELECTRO-ENUCLEATION VERSUS TONSILLAR COAGULATION\*

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**E**LECTROSURGERY is rapidly assuming its long awaited and rightful position as a valuable adjunct to medicine and surgery.

As is the case with all newly introduced agents, it has been made to run the gauntlet. In fact, electrosurgery has been subjected to more than the usual amount of bantering. It has proved to be a good advertising medium for the charlatan. It has been a good business proposition for the medical man, with the money first characteristic. These conditions will always exist. Therefore it is not the purpose of this paper to condemn individuals. It is intended that all attacks be directed toward a procedure as an entity. These attacks shall not be biased. They shall be supported by scientific proof. An endeavor will be made to thoroughly destroy an existing wrong procedure.

For years advocates of a specifically proved, pseudosurgical procedure will persist in their adulations, this support being continued despite scientific evidence to the contrary. This has been true of tonsillar coagulation.<sup>1</sup>

It is the hope that the thoughts here given will be granted consideration. Having been considered, that they will conclusively prove the error of tonsillar coagulation, as compared with any form of enucleation; this being particularly true of electro-enucleation.

Tonsillar coagulation means the application of a damped bipolar high-frequency current to the tonsil.<sup>2</sup> This is accomplished by thrusting a suitable electrode into the tonsillar tissue. (Figs. 1, 2.) This electrode usually consists of a slightly curved sewing needle, held in an appropriate handle. It is the active electrode.<sup>3</sup> The disbursing electrode is usually applied

through the close application of a large block-tin applicator. (Fig. 2.) This is applied to any convenient part of the body, usually the back. The complete technique consists of many thrusts by the active electrode into different parts of the tonsil. The current is applied by pressure on a footswitch at the completion of each thrust. In this way the desired, supposedly complete, coagulation of the tonsillar surface has been effected. Only one tonsil, as a rule, is treated at a time. Usually eight days are allowed to elapse before the other tonsil is so treated. This procedure is continued over more or less time, sometimes several months, until the tonsils have apparently disappeared.

As a result of coagulation, the tonsil in all instances is greatly reduced in size, even from the time of the first current application. This reduction in size is due to dehydration and tissue necrosis. It is possible to cause an apparent disappearance of the whole tonsil with but one application of this coagulating current. In these instances, however, great pain and marked dangerous edema in the surrounding soft parts result. Such heroic treatment causes severe subsequent sloughing and bleeding. This condition is not a necessary sequence. One adept in the use of the current and technique will not be thus embarrassed.

The claims made for tonsillar coagulation are many. The more important ones will be given. There is said to be an uninterrupted social or business life. It is said to be a painless and bloodless operation. Further that there is an immediate cessation of all local and systemic symptoms, this cessation being accompanied by a rapid return of the body to normal physiological functions, these functions having

\* Read before the Palm Beach Academy of Med., Oct. 26, 1928, and Dade Co. Med. Soc., Miami, Jan. 2, 1929.

been previously impaired by absorption from the focus of infection.

A true fact, regardless of the ability of

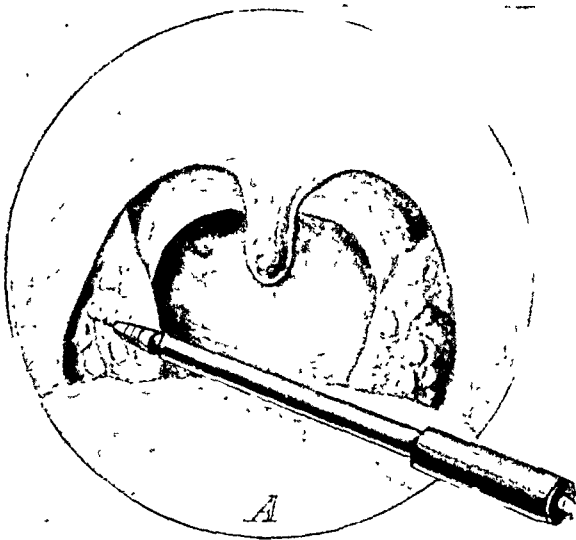


FIG. 1. A. Active electrode in process of coagulating tonsillar surface. White spots showing previous applications of coagulating current having been thus applied.

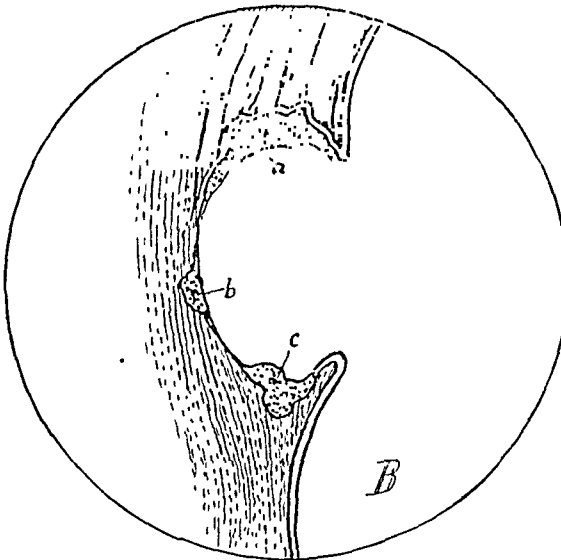


FIG. 1. B. Tonsillar fossa showing buried tonsillar tissue. (a) Superior pole; (b) a small piece of central lobe; (c) inferior pole.

the operator, is that a high frequency current is no selector of tissue, the directional forces being toward the discharging electrode (Figs. 2 and 3). It is therefore impossible to gauge the depth or breadth of coagulation when the current is used, as described in tonsillar coagulation. The

predominant idea of the operator is to cause no destruction to vital tissues. The realization of this idea, without leaving portions of tonsillar tissue, is an impossibility. If the process is carried far enough to cause the destruction of the entire tonsil, there will result a necrosis and edema of vital parts adjacent thereto. Great pain and bleeding will subsequently follow. This is particularly true of the superior pole of the tonsil. In the great majority of instances this portion reposes high up in the soft parts. It is completely surrounded by soft, vital tissues, excepting for its base. To completely necrose this submerged part must result in the formation of fibrous infarcts, in which more or less non-tonsillar tissue has been deprived of nourishment, causing its death. Irreparable damage has thus been done, this damage having been death to vital structures with subsequent malformations (Fig. 4), accompanied by great pain and danger

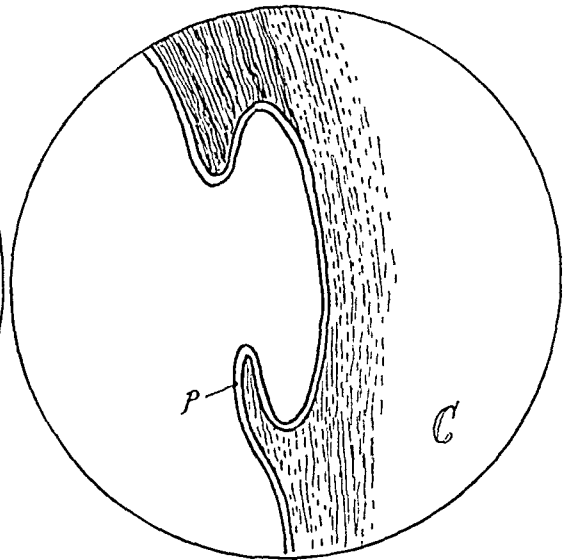


FIG. 1. C. A clean fossa. (p) Retained plica triangularis. (The writer in all instances attempts to retain this important anatomical structure. It is believed that its removal accounts for complaint of dry throats.)

to life. Through the exercising of great care, however, the usual end result is the complete detachment of the superior pole from the central lobe. The ever-protecting mucous membrane hurries its repair, thus quickly covering the denuded

base of this detached portion, this rapid repair undoubtedly being due to the stimulating effect of the current.

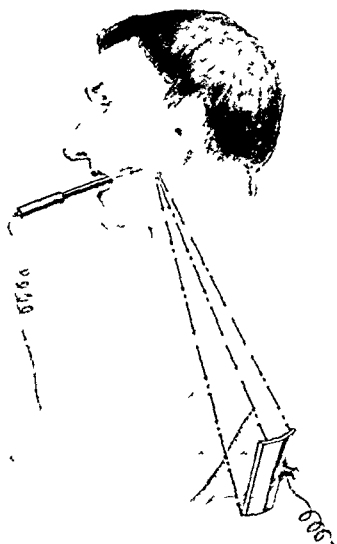


FIG. 2. Application of large discharging electrode to back, and active electrode thrust into tonsils. Directional forces of current are shown toward, or away from, tonsil into vital underlying tissues.

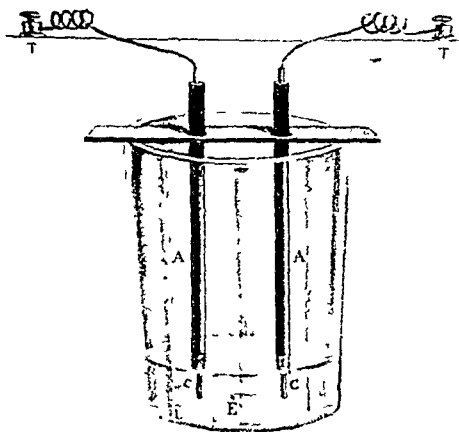


FIG. 3. Method of demonstrating double active electrode principle, showing directional forces. T, terminals of high frequency current. C, uninsulated portion of equal-sized electrodes suspended in egg albumen. E, Coagulated portion. This demonstration is only possible when current is applied gradually from zero to predetermined point for condition to be met. With any other application of current, it is impossible to prevent one or the other electrode from assuming rôle of active electrode. This procedure is accomplished by use of rheostatic foot switch, introduced by writer.

The result in a very short time following this separation is a complete smooth

clean covering of mucous membrane. This covering constitutes an absolute blind for the thus submerged tonsillar tissue.

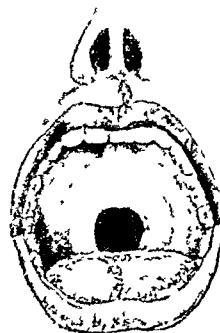


FIG. 4. Postoperative mutilation; anterior pillars and uvula have been removed. Posterior pillars have become attached to posterior wall of naso and oropharynx, resulting in partial occlusion of normal opening. (This occlusion is often complete.)

A like burying is of course possible, and is actually the case in many instances, in other parts of the fossa. (Fig. 1. B.)

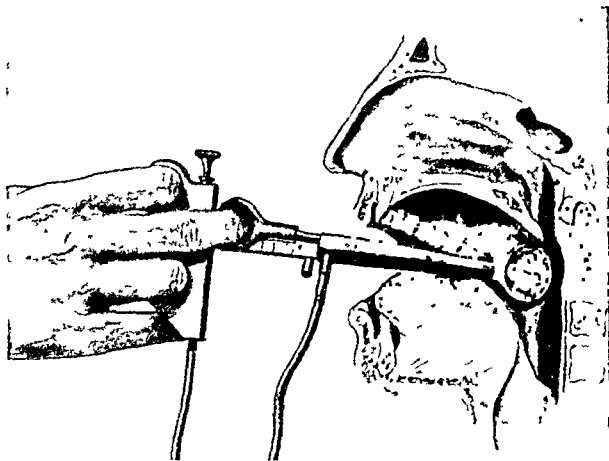


FIG. 5. Bipolar, electro-enucleating tonsillotome being applied to tonsil. Snare is active electrode, seizing forceps is discharging element.

The length of time before the buried focus in the throat will be manifested systemically is problematical. The factors determining it are: the size of the submerged piece of tissue, the size and virulence of the colonies of organisms contained therein, plus their ability to withstand local extermination, and to send out vanguards to the distant systemic points.

Local and systemic symptoms will subside, following any form of tonsillotomy, granting that this organ has been

obliterated. More often, however, they are but held in abeyance. The normal physiological activities are, for the imme-

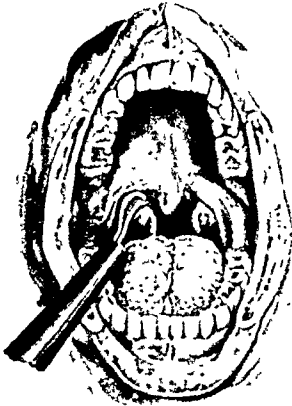


FIG. 6. Tonsil has been engaged, snare drawn taut. Seizing forceps have been closed. Current may now be applied. Carriage to be drawn backward simultaneously, thus severing tonsil at its base. Proportional current properties being 88 per cent cutting and 12 per cent coagulating. This proportion being maintained for various sized masses, by varying time element that current is held in contact.

the provocative cause thereof. The cessation of the systemic symptoms is the result of the respite granted the phagocytic

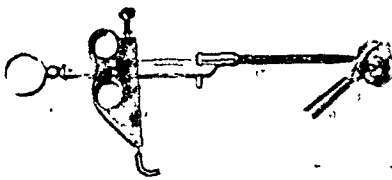


FIG. 7. Tonsil has been engaged in open snare. In this instance, snare has retained its position as active electrode. Discharging electrode is separate seizing forceps (Fig. 8).

forces. This respite is due to the partial reduction in the number of the invading organisms; and to more or less destruction of their primary breeding place, the tonsil. Thus this temporary cessation of hostilities at the primary source enables the protective forces to focus their attention on the more distant secondary systemic foci. In those individuals still retaining a fair amount of general resistance these secondary foci are oft-times completely



FIG. 8.



FIG. 9.

FIG. 8. Separate monopolar seizing forceps. This instrument may be used in connection with "radio-knife" or dissector (Fig. 9), in any type of surgery, i.e. removal of malignant tumors, etc.

FIG. 9. "Radio-knife," or dissector. May be used as stated (Fig. 8), or to fulgurate bleeding points.

diate time at least, allowed to function unhampered. In this way, a normal standard is approached.

It is well-known when an individual has sought relief from systemic manifestations of a primary focus of infection, the incomplete removal of this focus or the formation of a new one is early recognized by the return of these secondary conditions. They are usually in a more aggravated

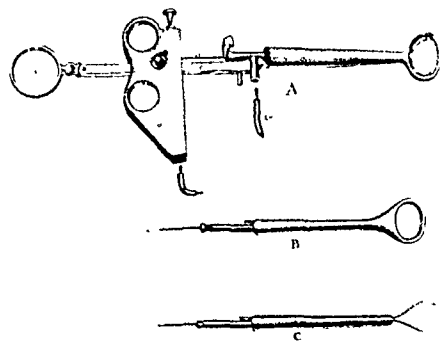


FIG. 10. A. Electro-enucleating tonsillotome with attached seizing forceps. (a) Snare wire which is active electrode; (b) discharging electrode connected to seizing forceps.

B. Interchangeable plain loop for use with separate seizing forceps (Fig. 8).

C. Interchangeable open snare for use in dissection method or for securing small pieces. Also used with separate seizing forceps.

form, and increased in dissemination, the end-result being a complete breaking down of the physiological entity. This complete

cessation of normal function oft-times is hastened by the ease of invasion of an epidemic organism, the protective powers of the body being unable to cope with this new menace, because of the existing endemic situation.

Rhoads and Dick<sup>5</sup> have presented what seems to me an excellent treatise on this particular subject. I am herein presuming to quote *verbatim* their comments and conclusions:

#### COMMENT

The most frequent object in removing tonsils is to rid the body of tissue harboring bacteria capable of producing disease in other parts of the body.

Yet it is shown by this work that tonsillectomy as usually done, even by specialists of established reputation, fails to accomplish this end in 73 per cent of cases because of incomplete removal of infected tonsillar tissue.

There is even some indication that in many instances the condition resulting from incomplete tonsillectomy is worse than that existing before operation.

#### CONCLUSIONS

Pieces of tonsillar tissue of appreciable size were found in the throats of 73 per cent of persons who had undergone tonsillectomy.

That these "tonsil stumps" have considerable clinical significance is shown by the fact that in the fairly large series in which cultures were taken the "stumps" harbored more pathogenic bacteria per gram than tonsils removed for the first time. Also there are clinical cases in which patients with systemic diseases attributable to foci of infection failed to improve after their original tonsillectomy but improved strikingly after removal of the pieces of tonsillar tissue remaining from the first operation.

The complete removal of all tonsillar tissue is necessary when the operation of tonsillectomy is undertaken.

With these most fearsome possibilities ever present, why should tonsillar coagulation continue to exist as a procedure? To further nullify its right to continued use, is the existence of a method, or procedure, which does all that may have

been claimed for tonsillar coagulation, plus the eradication of its now known dire possibilities.

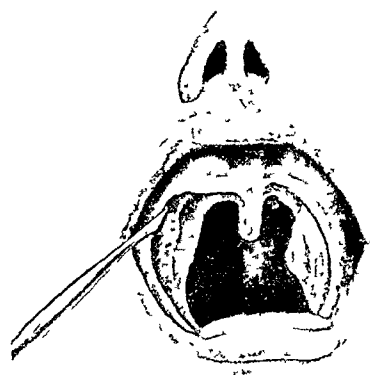


FIG. 11. Sinus tonsillaris, after removal of tonsil (right). The anterior pillar is held aside to show cleanliness of removal. It also shows total lack of undue traumatization of vital structure.

Tonsillar electro-enucleation, as implied, removes the tonsil *in toto*, immediately. A full descriptive technique will not be given here, this having been done on several previous occasions.<sup>1,4</sup> The results, however, of tonsillar electro-enucleation are:

1. The tonsils are removed in their entirety with one operation. (Figs. 5-10.)

2. The operative and postoperative results are bloodless. This renders the visibility of the operative field excellent, thus preventing the possibility of failure to remove all affected tissue. It also thus safeguards all vital structures. (Fig. 1c.)

3. There is a minimum of traumatization of tissue, owing to the ease of manipulation, and the total lack of the necessity of suturing. This reduces post-operative infection to a minimum. (Fig. 11.)

4. The normal instantaneous coagulation of the lumen of the severed vessels renders nil the possibilities of systemic involvement due to metastasis. This fact, especially in the case of malignancy, is a crowning attribute.

5. There is a stimulating effect to the underlying tissues affected by the current, which hastens repair.

6. The psychological impressions, which are always favorable, are not confined to the patients or their parents, but are manifested in the confidence of the operator.

In closing, it is the earnest hope of the

writer that any remarks in this paper will not be so misconstrued as to imply other than a sincere desire to protect, primarily, our patients; secondarily, to prevent us, of the profession, from being unwittingly enmeshed.

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## OFFICE TREATMENT OF HEMATOMA\*

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THE major injuries associated with blood effusion, e. g., hemothorax, perirenal hematoma, and hemarthrosis of the large joints, obviously do not fall within the limits of the title of this paper, which deals with the lesser hematomas of ambulatory patients.

A hematoma, in reality a subcutaneous wound, is a collection of extravasated blood, limited in its extent by the character and resistance of the surrounding structures. In actual practice the term is restricted to blood extravasations which are definitely circumscribed and tend to be spherical in shape. Apart from hemophilia, scurvy, the purpuras and the leucemias, the origin of a hematoma is invariably traumatic.

Section of a hematoma a few days old usually shows a collection of blood-clot with a soft, often fluid, center made up of blood serum. The periphery is firm and organization is taking place there. If the

hematoma is located near the skin surface, there will be a series of color changes at first dark blue, then reddish-brown, greenish-yellow, and finally a dirty yellow. The duration of the staining is variable but eventually there is complete return to normal. The clot may terminate in complete absorption or in a small mass of fibrous tissue; rarely suppuration may set in and the course will then be that of a subcutaneous abscess. Still more rare is the formation of a blood cyst with well-formed fibrous wall and yellowish-brown fluid contents frequently containing cholesterol crystals. Ossification is infrequent but occurs insubperiosteal hematoma, and particularly following large deep hematomas of the thigh where it appears in the x-ray as a lamina external and parallel to the cortex of the femur.

Diagnosis can usually be readily made in recent cases but in the later stages doubts may arise because of heat, tender-

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ness and fluctuation or when the swelling is deeply situated complicating conditions must be excluded by the usual methods.

Judging from the comic papers, hematoma is very common in the scalp. This is far from being the case as a linear wound is the usual lesion. The classic differential diagnosis between depressed fracture of the skull and hematoma of the scalp need cause no concern as skull fracture in the absence of a scalp wound is practically unknown in adults.

In the well-known "black-eye" the effusion appears very rapidly but if firm pressure be applied immediately it may be successfully limited; however, if an hour has elapsed nothing is to be gained from such treatment; a small piece of adhesive placed along the eyebrow will, in some measure, conceal the bruise.

Hematoma of the ear occurs among boxers, wrestlers, and foot-ball players. In untreated cases it results in the unsightly "cauliflower ear." Immediate treatment should succeed in evacuating the effusion as far as possible through a short incision made in the fossa of the helix, with strict asepsis. A small sterile pad is placed over the wound and a moulded soft copper wire is applied to the fossa of the helix. The auricle is then lightly padded and firmly bandaged to the side of the head. The dressing may be removed after forty-eight hours when there is little fear of the destruction of the cartilage which results in "boxer's ear." It may be noted as a curiosity that hematoma of the auricle was so common in hospitals for the insane that it was known in England as "insane ear."

Hematoma of the nasal septum may occur following trauma and should receive the attention of the rhinologist.

Injury to the female breast not infrequently results in a hematoma which may give rise to confusion in diagnosis. Spontaneous absorption is the usual course. Hematoma of the abdominal wall may be due to trauma, rupture of the rectus muscle or bleeding from the superior or inferior epigastric vessels. The diagnosis

is seldom made in bleeding from the epigastric vessels, the hematoma being recognized usually in the course of laparotomy.

Hematoma of the thigh or calf presents no unusual features. In the case of hematoma of the shin, there may be pain for a considerable period of time due to the subperiosteal hematoma frequently referred to as "bone blister." In the perianal region the thrombotic hemorrhoid, really a subcutaneous clot, is of common occurrence and is readily evacuated under local anesthesia. The subsequent small wound heals rapidly.

Hematocele of the spermatic cord or tunica vaginalis is not uncommon. The effusion into the cord may be safely left to absorb. In the case of the commoner scrotal hematocele there may be considerable difficulty in diagnosis. For this reason when there is reasonable doubt it is safest to advise exploration of the scrotum, having first obtained permission for orchidectomy, so as to deal with the pathological condition present. This, of course, is not an office procedure.

Crushing injuries of the hand and foot sometimes cause large diffuse hematomas. In these cases it is important to exclude fracture by x-ray. Blows on the nail or squeezing injuries may cause subungual hematoma which slowly absorbs, frequently with loss of the nail. If the nail is loose it may be easily removed, with or without block anesthesia. The only possible diagnostic difficulty is the occasional masquerading of a subungual melanotic tumor in the guise of a hematoma, and consequent delay in radical treatment.

*Treatment.* In certain early and selected cases, incision and evacuation of the clot with subsequent application of a pressure dressing meet the indications. Notably is this the case with the auricle and the thrombotic external hemorrhoid. With these exceptions and in the absence of pus formation, intelligent neglect is probably best and under conservative measures, absorption and complete resolution may be confidently anticipated in near-



ly all cases. Judicious employment of heat, the whirlpool bath, light massage, and moderate pressure are of assistance in the removal of the serum and clot. Movement both active and passive stimulates the circulation and prevents adhesions and atrophy of muscle. Suppuration should be watched for but a word of caution is necessary. More often than not, a hot tender semifluctuating swelling following

some days after an injury and associated with mild pyrexia is found on incision to be free of infection. In other words, it is difficult to be sure of the presence of pus in a hematoma, and aspiration of pus should precede incision. A blood-cyst will in relatively recent cases be satisfactorily healed by aspiration; old-standing thick-walled cysts, however, require complete resection.



## THERMAL AND CHEMICAL INJURIES\*

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IN the treatment of thermal and chemical injuries, the doctor must have at his command the various agencies that he will have to use in treating the lesions. The first requisite is to relieve pain, combat shock and to dress the wound so that infection will not set in. For pain use hypodermic injection of morphine, for shock use stimulants and maintain heat by means of hot-water bottles.

First-aid treatment of injuries is the prime requisite of the doctor so that the course of healing will go on without interruption. Many of these cases, however, come to the office already infected. An infected wound, whether from burn or other injury, should be treated at once with the idea of relieving congestion and avoid spreading of the infection. Splinting the parts and putting the tissues at rest is the first essential. Removal of foreign bodies and the cutting-away of dead tissues will facilitate drainage.

Should there be evidences of pus formation in the deeper tissues, incision and putting in a wick moistened with tr. iodine or mercurochrome will afford further drainage. Having placed the parts at rest and given free drainage, the wound should be covered with gauze saturated with a solution of boracic acid. Be sure

to have the entire gauze covered so that the gauze will not dry.

The treatment of burns depends upon the degree of burn. The superficial burn of the epidermis which has produced the formation of serum is best treated by incising the membrane and allowing the serum to escape. If the area burnt is not too large, the raised epidermis can be cut away entirely, leaving the denuded area to be treated with moist dressings of boracic acid or a 2.5 per cent aqueous solution of tannic acid.

Should there be an extensive burn apply either boric acid or compresses saturated with 2.5 per cent freshly prepared aqueous solution of tannic acid or gauze moistened with 1 per cent or 2 per cent picric acid solution and apply bandage. This will be sufficient protection for transference of the patient to either home or hospital for further treatment by any of the well-known methods. If the burn is extensive, skin grafting should be done early. If performed early before much cicatricial tissue has formed, the graft will be more apt to adhere.

Deep electric burns are very tenacious and resistant to treatment. Avoidance of infection, cutting away sloughs as nature loosens up the areas, application of nitrate

\* Submitted for publication November 25, 1929.

of silver here and there and the boric ointment or zinc oxide ointment will stimulate the healing.

In frost bite initial treatment is the most important point. Avoid putting the parts in hot water at first, but attempt to bring back the circulation gradually. If the skin is livid and not yet gangrenous treat the parts by friction with snow or rubbing with towels soaked in iced water. Then as the skin becomes warmer and congestion disappears dry friction should be used and the parts wrapped in cotton.

Should there be gangrene of any of the parts it is a good rule to wait for a definite line of demarcation. Do not be too hasty to amputate.

Chilblain is a secondary effect of cold. Rub the parts daily with alcohol and apply friction with a coarse towel. For hyperemia

of the skin use zinc-oxide ointment to which a small quantity of carbolic acid or menthol has been added to relieve the itching.

In handling cases resulting from chemical burns, such as carbolic or nitric acid, the resulting necrotic area must be dressed either with boric powder or a solution of boric acid. If the gangrene is not deep the dead skin can be cut away and the underlying parts will in time slough away. Should gangrene be present in parts of fingers or toes one must again wait for a definite line of demarcation before amputating.

Roentgen-ray and radium burns are most difficult to manage, and heal slowly. After the ulcerating area has healed skin grafting in the shape of thick flap grafts have been most successful and resulted in prompt healing.



## SURGICAL CONDITIONS OF THE EAR\*

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**I**N otology, as in the practice of any other surgical specialty, there are several pathological conditions which lend themselves safely to surgical treatment in the office. Such surgery, of course, is understood to be the performance of a minor operative procedure which does not in any way interfere with the patient's return to his home soon after. Anything that might possibly arise to necessitate confinement to bed contraindicates the performance of surgery in the office.

Ordinarily, the performance of a myringotomy, the removal of an aural polyp or granuloma, the removal of a necrotic ossicle, the incision of an abscess in the soft parts and the removal of cysts of the auricle can safely be done in the office and the patient sent home soon afterward. In each of these procedures certain precautions must be observed; and contrain-

dications exist at times which preclude the use of surgery in the physician's office. It is not the purpose of this paper to set forth the indications for operation, but merely to formulate a set of didactic rules for the contemplated procedure.

A myringotomy is usually more aptly performed, and the incision more correctly placed, in children above the age of three years and in adults who are extremely nervous, when the patient is given a general anesthetic. In children the use of ethyl chloride inhalation, administered so that an analgesia rather than an anesthesia is produced, does not in any way interfere with the patient's return to his home. Adults who require an anesthetic are best sent to a hospital where they can stay over night until the effects of the narcosis completely disappear.

As a rule, however, no anesthetic what-

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soever is needed. Children are mummified and the head held tightly by an assistant during the surgical procedure. Adults are told that an incision will be made in the drum which will cause a certain amount of pain, but that this pain will be no more severe than that which the disease itself is causing them. Some otologists employ a mixture of cocaine and phenol as a local anesthetic applied to the drum.

The myringotomy itself should always be performed in such a way that the knife at no time impinges on the inner tympanic wall, for injury to the latter exposes the labyrinth to infection. Strict surgical asepsis should be observed so as to minimize the danger of a secondary infection. In infants, especially, care must be exercised not to incise the skin of the external canal, since injury to this structure may be followed by infection and cellulitis of the soft tissues.

Aural polyps and granulomas also lend themselves to office surgery. Before operation is undertaken, however, one must be certain of the exact origin of the new growth. These conditions are usually found in the chronic otorrheas, both with and without bone necrosis. They are a result, either of an exuberant connective-tissue proliferation following an irritant or of the confluence of the connective-tissue resorption foci in the bony tympanic walls which indicate the area of sequestering bone. The former type is found in chronic purulent otitis media due to suppuration of the tympanic mucosa. The lesion usually springs from the inner surface of the drum, the mouth of the Eustachian tube and, occasionally, from the promontory. The latter are found in the necrotic otitis of scarlet fever and in the chronic otorrheas of the dangerous type, including cholesteatoma and tuberculosis. They usually spring from the attic and their base is broad and formed by the connective tissue of the resorption foci in the bone. Through this connection they may be in intimate contact with the membranous labyrinth, if the bone is entirely necrotic;

or a path for the spread of infection exists preformed through the vascular channels leading from the granuloma into the bone. These are the polyps which should only be removed by a radical mastoid operation, never through the external auditory meatus. Those springing from the other sources already mentioned may safely be removed in the office.

Polyps are best removed with the cold snare. They should never be pulled out. The procedure that I follow is to remove the greatest portion of the polyp until the base and attachment are clearly discernible. I then cauterize the base at a second sitting with either silver nitrate or trichloroacetic acid. Hemorrhage following this operation is usually negligible and is easily controlled by the application of adrenalin chloride.

In this connection, we may consider also the removal of the granulations which form after a radical mastoid operation. These are the result of ingrowth of the implanted squamous epithelium over the healthy connective tissue granulations which spring from the raw bone surface and of the irritating effect of one upon the other. They are always noted at the margin between the squamous epithelium and the granulating surface. I have found that they usually disappear of themselves and rarely need to be removed. As the epithelium advances, it covers these exuberant granulations and finally covers them; and the granulations recede and shrink. If they become excessive, however, and tend to delay epidermization, they may be removed with the curette or with a small biting forceps.

The removal of polyps and granulomas is best done in the office under local anesthesia. A 1 per cent solution of novocaine containing a few drops of adrenalin is injected at the posterosuperior angle of the external auditory canal. About 2 c.c. are sufficient to anesthetize the entire middle-ear mucosa.

Rarely is one called upon to remove a necrotic ossicle. Occasionally, however,

cases of chronic suppuration with a marginal perforation are seen wherein the entire middle ear has been healed and covered by epidermis and wherein a discharge still exists although no cholesteatoma is present. In such cases an isolated necrosis of the malleus or the incus is often found to be the offender; and a removal of these necrotic structures will cause a cessation of the lesion. Where the malleus alone is involved, it can safely be removed in the office, employing the method of anesthesia just mentioned. The portion of the drum attached to the malleus is incised with longitudinal incisions placed on either side of the malleus and extended upward until the outer bony attic wall is reached. The malleus is then grasped with a Hartmann forceps or other suitable instrument and gently rotated until its articulation with the incus has been severed. The attachment of the tensor tympani muscle is cut through with a small tenotomy knife placed anterior to the long process. The severance of this muscle should be done by carrying the cutting edge of the knife first upward and then downward and outward. The malleus is then removed gently. Where it is necessary to remove the incus, also, the entire procedure had best be performed in a hospital, since the danger of disturbing the stapedio-fenestra articulation, with a resultant labyrinthitis, is too great to risk in the office.

The incision of a fluctuating abscess of the soft tissues of the auricle, canal or mastoid process can be performed in the office provided that the abscess is not the result of a suppurative mastoiditis. In the latter instance, the subperiosteal abscess is part of the suppurative mastoiditis and should be treated at the time of mastoidectomy. Other abscesses, such as those due to broken-down lymph glands, furuncles or post-erysipelatous foci of purulency, can be incised with the use of a local anesthetic, preferably ethyl chloride sprayed over the affected area.

A recurrent acute infection of a mastoid previously operated upon will often evince

itself by a bulging of the scar due to an accumulation of pus within the mastoid cavity. Where the surgeon himself performed the primary operation and has an exact record of the anatomy of the parts and the areas of endocranium exposed, in such a case of recurrence he may safely incise the protruding area in the office and evacuate the pus. Where someone else has performed the original operation, it is better to hospitalize the patient and carefully expose the mastoid wound. I have in mind one such case wherein the incision over the mastoid area was found, upon reoperation, to be placed directly over a large area of exposed cerebellar dura. Had this case been incised in the office, the incision would have penetrated the dura and entered the cerebellum.

Sebaceous cysts of the ear which are situated above the auricle and are not intimately connected therewith can be nicely dissected from their bed under local anesthesia. This can be done in the surgeon's office. An injection of 1 per cent novocaine around the area of operation completely blocks it and renders it painless during the surgical procedures.

There are certain general conditions which influence the decision of the physician as to whether or not he should perform an operation in his office. Debilitating diseases such as diabetes, tuberculosis, chronic nephritis and arteriosclerosis contraindicate office surgery. The complications that these conditions bring about in themselves warrant hospitalization for the benefit of the patient and the legal protection of the doctor. Then again, there are some highly neurasthenic and impressionable individuals who will always magnify postoperative symptoms. These people are very difficult to treat after operation in any event; and they are likely to believe that the surgeon minimized their condition at the outset by operating upon them in the office. They will always feel that had they been sent to a hospital and proper emphasis placed upon the

seriousness of their condition at the start, they would not have had the same amount of suffering. All this, as well as the patho-

logical condition itself, has a bearing on whether or not a surgical procedure should be undertaken in the office.



## SEBACEOUS CYSTS\*

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**S**EBACEOUS cysts are tumor masses occurring in the skin and are due to the occlusion of the ducts of sebaceous glands. They are most prone to occur on the head, face, and neck but may be found anywhere that sebaceous glands occur. They vary in size from that of a small pea to that of a walnut, and inasmuch as they arise from the skin itself the skin is not freely movable over them. They consist of a discreet sac filled with a cheese-like substance, the result of sebaceous gland secretion.

Treatment consists in complete removal by excising a small ellipse of skin over the apex and dissecting the sac out intact. If infection is present incision and later a complete and more difficult dissection may be necessary, but the whole sac must be removed or recurrence is likely. If there is any question as to whether any sac remains the cavity should be swabbed with phenol and alcohol and twenty-four hour drainage instituted.

### TENDON CYSTS

The most frequent site of tendon cysts is about the wrist or over the dorsum of the hand. When present they are easily brought into relief when the tendon is put on the stretch.

They consist of very thin walled sacs of synovia-like material about the size of a small cherry and are filled with a clear straw-colored, very thick gelatinous material which can only be aspirated through a large bore needle. Though of the tendon sheath, there is no open connection with it.

*Treatment.* Occasional cures are secured

by putting the cyst under tension and smashing by a sudden blow of a book. Aspiration and continued pressure may relieve a few, but the injection of an irritating substance such as iodine is not advisable. The only sure method is to remove them completely, which is easily done if the sac is not ruptured in the process. Those occurring on the deep tendon of the wrist are somewhat more difficult and require more care in dissection.

### PREPATELLAR BURSITIS; HOUSEMAID'S KNEE

The prepatellar bursa, situated in front of the patella, may become inflamed from acute or chronic traumatism, more often the latter and seen most frequently in persons whose work requires constant kneeling. The bursa when distended may vary in size from that of a small pullet's egg to that of half an orange and may or may not be acutely tender. It is not connected with the knee joint.

*Treatment.* Acute cases may sometimes be relieved by aspiration and tight adhesive strapping for a prolonged period, repeating the aspiration as indicated. If this does not suffice they should be completely removed. In chronic cases, especially those in which rice-bodies are present, removal is almost always indicated. This can be accomplished fairly easily under local anesthesia by means of an elliptical incision, removing sufficient skin for neat closure, and careful dissection to remove the sac intact. Close without drainage and apply pressure. No disability results from the absence of the bursa.

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# TREATMENT OF FLAT FEET\*

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PAIN in the feet and legs is one of the most common of ailments and one that is very distressing in its effect both mentally and physically. The proper treatment of such pain naturally presupposes the proper diagnosis of the condition causing the pain. Various conditions will cause pain in feet and legs. Flat feet must be differentiated from the following conditions: Intermittent claudication and sciatic pain caused by arthritis or low back strain. A careful history that the pain comes after walking two or three blocks and stops as soon as the patient stops for a moment or two, combined with the inability to palpate the dorsal artery of the foot is practically diagnostic of intermittent claudication. To eliminate sciatic pain from our diagnosis it is necessary to examine the back for tenderness about the sacroiliac joint, to apply the Kernig test, i.e., straight leg raising, and also the history should show that the pain really travels downward in most cases at least, instead of upward. Eliminating these two causes in the feet and legs, there are three main groups of foot disability: foot strain, weak foot, and flat foot. The flat feet are of two kinds, the flexible flat feet and the rigid flat feet.

## TYPICAL SYMPTOMS OF FOOT DISABILITIES: ALL DEGREES OF DISABILITY FROM SLIGHT TO EXTREME

There is an aching in the feet and legs with a greater tendency to tire, especially upon standing or walking. This aching is usually relieved by rest and the removal of weight-bearing. It is often relieved also, by rest in bed, hence is much better in the morning, comes on again toward noon and then after a rest returns in the afternoon. It is relieved by bearing weight on the outer sides of the feet. Therefore, examination

of the heels of such patient's shoes, will often disclose their being worn. These feet are sometimes subject to excessive perspiration due to interference with the circulation, and are often cold and clammy.

Such patients are often able to walk long distances, but upon even short periods of weight-bearing in standing position, the feet ache excessively. These patients have slovenly gaits, the feet are everted and the knees bent inward. Upon examination the feet of these patients divide themselves into three groups: simple foot strain, weak feet, and flat feet. In foot strain the foot is very flexible but even upon weight-bearing there is very little eversion of the foot, although marked tenderness is produced upon pressure beneath the astragaloid scaphoid ligament. This is a rather acute condition as will be brought out in the history.

There is another group of feet, however, which I classify as weak feet in which there is marked eversion of the fore part of the foot, prominence of the scaphoid, and many times complicated by a short heel cord which does not allow the foot to be dorsiflexed beyond a right angle.

Another variety of painful feet is known as flat feet. These divide themselves into the two groups, flexible and rigid. The flexible flat feet, are relaxed and everted with the scaphoid many times flat upon the ground, entirely obliterating the longitudinal arch. There is another type of flat feet known as rigid flat feet which are stiff in this pronated position with more or less spasm of the peroneal muscles which can easily be demonstrated upon attempting to supinate the foot.

One other type of foot disability is known as anterior metatarsalgia or Morton's toe, which is a most painful disability in the fore part of the foot. There is a

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painful cramp or needle-like pain in the region of the base of the fourth toe and extending into the fourth toe. This pain is periodic and when it comes is intolerable but is relieved usually by removing the shoe, massaging and manipulating the joints of the anterior arch of the foot. Many times a callous is demonstrable on the ball of the anterior part of the foot which is a compensatory thickening of the skin, nature's attempt to keep the bone from wearing through the skin. This is more frequently girls and women than in men, although some men do have it. It may or may not be present along with a flat longitudinal arch.

#### ETIOLOGY OF THESE VARIOUS CONDITIONS

These foot disabilities are usually caused by inability of muscular effort to bear the weight. In most cases there is a laxness of ligaments which is very commonly overlooked, but can easily be demonstrated not only in the foot, but by hyperextending the elbows, etc. Because of this relaxation of the ligaments, strain is thrown upon the muscles, hence the pain comes from muscle strain and tire and not directly from the flat foot *per se*. A standing occupation is often the cause throwing the constant strain upon these muscles. Bad shoes are most fruitful causes of foot disability. The modern shoe manufacturer has very little regard for the proper lines of the foot in the manufacture of shoes. They make a pointed toe which has the same curve on the inside as on the outer side. Of late, shoes have been made of most inelastic leathers, such as snake and lizard skins, which cannot be stretched to relieve pressure on the toes and joints. Also the high narrow spike heels that many women wear throw practically the entire weight of the body upon the fore part of the foot and produce a very marked instability, although some of the weight is carried underneath the longitudinal arch, because the French variety of heel is

actually forward beneath the scaphoid. All these factors result in stretched ligaments. Even new facets are formed on the bones near the normal joints after long periods of time.

Osteophytes and thickened periosteum are found in the variety of rigid flat feet which is often complicated by arthritis. There is marked muscle atrophy of the unused muscles and contracture of certain of the muscles, especially the calf and peroneal muscles.

#### TREATMENT OF FOOT STRAIN

Slight cases only require wedging of the heels  $\frac{1}{8}$  or  $\frac{1}{16}$  inch on the inner sides of the heels, combined with exercises. These exercises consist of actively adducting and dorsiflexing the foot forcibly into supination position and flexing the toes and holding this position for fifteen seconds, then relaxing for a few seconds, and repeated fifteen to twenty times twice a day; also a walking exercise which consists of walking barefoot or in stocking feet on the extreme outer sides of the feet with the foot adducted and supinated as in the aforementioned exercises. The patient should take one hundred steps about the room both morning and evening. Exercises of rising on the toes, in my opinion, often are not so good because they have a tendency to shorten and contract the heel cord and calf muscles.

A pad of saddler's felt carefully shaped and beveled and strapped beneath the foot by adhesive plaster with the foot well supinated, gives immediate and wonderful relief in cases of foot strain. These should be renewed twice a week for two or three weeks and then discarded and combined with wedging and exercising.

More extreme cases require these same exercises and wedging of the heels only, not the soles, for wedging of the soles merely tips the foot over by rotating in the subastragaloid joint, and does not help the longitudinal arch. It was formerly thought necessary to fit such cases with

arch supports of metal, either molded on the Whitman or Boston models, but of late years I have used a shoe which is manufactured with rigid shanks using a strip of steel which, in my experience, very seldom breaks. This shoe, combined with a simple insole in which is a felt pad inserted in a pocket, makes a very light and efficient support so that very seldom is it necessary to fit a steel support.

Extreme degrees of flat feet are of two kinds, flexible and rigid and need entirely different treatments. Even the extremely flexible flat feet that give symptoms are best treated by strapping, padding and exercises, plus a rigid arch shoe with heels wedged on the inner sides.

The personal equation, however, has to be considered when it comes to giving exercises, as some will, and many will not, do them. The most doubtful ones are the young girls of sixteen and eighteen years, in girls' schools away from home.

Some of these flexible flat feet particularly in older people, will need rigid steel plates, combined with massage. The rigid flat foot cases are a more serious problem. Some are merely irritable and after putting into casts at rest for a few weeks in supination, followed by massage and adhesive strappings, will soon clear up. Others with marked rigidity and peroneal spasm holding the foot in extreme pronation will require ether anesthesia and severe manipulation and stretching of the peroneal tendons before the reflex spasm will let go. This to be followed with plaster casts for several weeks, massage, adhesive strappings, and an external bar caliper brace for several months. This usually results in a cure, but sometimes has to be repeated.

#### ANTERIOR METATARSALGIA OR MORTON'S TOE

The diagnosis of this condition is so easy that it can many times be made over the telephone from the history. Upon examination, there is an acute tenderness upon pinching of the fourth metatarsal head between the thumb and fore finger. The cause of this condition is nearly always due to high heels and the narrow-toed shoes with the flexible sole. The fifth metatarsal head which should make one of the supports of the anterior or transverse arch is elevated so that the fourth metatarsal head becomes the buttress of this arch. The lateral pressure of the shoe causes the fifth head to pinch the fourth digital nerve between these metatarsal heads. Many times a callous is seen beneath this fourth metatarsal head and short heel cords is a very frequent complication.

#### TREATMENT OF METATARSALGIA

A proper shoe is an absolute necessity for the relief of this painful condition. Plenty of width and not too high a heel is necessary. In women, a low Cuban or military heel is allowable. Where formerly a metal anterior arch support was always used, I now use a felt pad either glued into the shoe or fastened into an insole of a rigid arch shoe.

In a very few, and those most extreme cases, an excision of the fourth metatarsal head has been done. For men, in whom this condition is rather rare, an anterior heel devised by Robert Jones of Liverpool for use in the army, is very efficient. This consists of a strip of sole leather fastened obliquely across the sole of the shoe just behind the metatarsal heads.





## MINOR PATHOLOGY OF THE VULVA\*

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THE vulva, in spite of its exposure to skin germs and its proximity to the three greatest excretory orifices of the body, the anus, the urethra and the vagina, exhibits surprisingly little pathology. Small infections heal promptly and systemic infections rarely develop from it, circumstances which can be explained only on the basis of relative immunity of the vulvar skin. On the other hand, the treatment of vulvar lesions is far from satisfactory. For one thing, the pathology is on the borderline of two specialties, gynecology and dermatology; the structures concerned are definitely gynecological, yet the diseases exhibited are frequently definitely dermatological; the result is that neither specialist assumes full responsibility for them, and treatment is often incomplete and ineffective.

In the second place, while the majority of these lesions are of a minor character, there is a tendency, and I think a very unhappy one, to treat them all as of this sort. Nothing could be further from the facts. The treatment of diseases of the external genitalia implies considerably more than a mere dabbing of superficial surfaces with one lotion or another. It implies, first of all, a most accurate and careful diagnosis before any treatment at all is instituted, and it is just here that most therapy fails. Vulvar conditions are very frequently merely a local manifestation of constitutional disease. Venereal conditions of the external genitalia have an unfortunate way of extending upward if they are not properly handled. Finally, while cancer of the vulvar structures, as Taussig points out in his latest brilliant study of the subject, is next in benignity to fundal cancer, this holds true only if our prophylactic and therapeutic measures are wisely chosen and properly applied.

And this, I would point out, is not always the case because of the very tendency I have mentioned, that of regarding all vulvar pathology as of a minor character.

The treatment of vulvitis is based primarily on a determination of its causal agent, which may be an infecting organism, usually the gonococcus, less often the colon bacillus; a constitutional condition, such as diabetes; irritation from chronic discharges high in the genital tract; infection from minor skin abrasions; ordinary lack of cleanliness; or skin diseases such as eczema, herpes, infection of the hair follicles and other skin conditions common to all integumentary regions, which possess no special local characteristics and which are more properly handled by the dermatologist.

The urethra, because of its location, is ordinarily considered as one of the vulvar structures, and it may properly be included in this discussion because gonorrheal infection is perhaps the most common cause of vulvitis and the urethra is the most common point of origin. Urethritis is seldom seen in the acute stage, and if it is, the proper treatment is absolute rest in bed, particularly during the menstrual periods, if the infection is to be prevented from extending upward. This, however, is not always practical, and, because the disease gives rise to no general symptoms, it is not always submitted to by the patient. Ambulatory treatment, therefore, becomes a matter of expediency if not of wisdom. In such cases, treatment should be strictly limited to the affected parts, and should include little more than dilatation of the lower third of the urethra with a small cystoscope, and painting of this part of the canal with mercurochrome, silver nitrate, or some similar agent in solution strong enough to kill the organisms, yet

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not strong enough to desquamate and injure the tissues. When the disease has reached the chronic stage, and the organism is intrenched in the tissues and cannot be isolated in the discharge, the mere fact of urethral involvement, especially if it is associated with involvement of the urethral and vulvovaginal glands, is so constant in gonorrhea and so unusual in other types of infection, that one might make the diagnosis merely on the history of exposure, plus the typical, flea-bitten appearance of the parts. The same type of local treatment is applicable as in the acute disease, and it must be kept up faithfully and persistently before a cure can be looked for. Isolation of the patient from the source of her infection is, of course, essential. I think it only fair, in view of the excellent results they report, to mention the treatment employed by Kidd and Simpson in their clinic at the London Hospital, urethrovesical lavage, instruction in which is given the patient herself if daily visits to the clinic are not practical. I should hesitate, however, to advocate such radical treatment by the average physician, let alone by the average patient, for I do not see how extension to the bladder and to the upper genital tract can well be avoided.

If Skene's glands are involved, the duct openings of which are evident in parous women as red areolae (in nulliparous women they can be exposed by hairpin retractors or fine silver probes) local applications are seldom efficacious, and the swiftest and surest treatment is cauterization with carbolic or preferably the electric cautery, after the duct has been slit over a probe from the urethral side. Bartholinitis sometimes responds to local treatment, but if abscess formation occurs, dissection of the entire gland is imperative in most cases. The operation is not serious in itself, but it is not an office procedure because of the danger of hemorrhage.

If the vulvitis is due to lack of cleanliness, the remedy is plain. The patient should be

instructed to pay special attention to the folds of skin about the genital orifice, and should be advised of the necessity for special care after urination and defecation. In the type of vulvitis which is caused by retention of sebaceous material and smegma about the clitoris, the adhesions about the latter structure are separated, the top of the preputial folds snipped off, and the edges united with two or three catgut sutures. This is a practical office procedure, for hemorrhage is a most unlikely complication.

An investigation of the urine should not be omitted in any case of vulvitis not due to such obvious causes as those we have mentioned, especially if pruritus is a prominent symptom. The decomposition of diabetic urine is a fairly frequent cause of this condition, and the treatment is obviously the correction of the constitutional disease.

Vulvitis may also be caused by any discharge from the cervix, vagina or rectum, and here again the treatment of the disease is the treatment of the causative condition, whether by douches, local applications, curettage, dilatation of the vagina or cervix, or the use of the cautery. The patient's word should not be taken for the existence or non-existence of a discharge. A careful local examination should be made, with microscopic study of the secretions, and the treatment instituted according to the indications. Savill in this connection calls attention to a frequent and unsuspected cause of vulvitis, the leakage of mineral paraffin preparations from the rectum, which may set up an intense vulvar irritation, though the anus and perineum are unusually unaffected. In such cases, withdrawal of the offending agent promptly clears up the condition. I would mention, too, the recent work of Greenhill and Davis on the trichomonas vaginalis, this organism having proved to be a rather frequent cause of a persistent and irritating leucorrhea, and so the cause of vulvitis.

The local treatment of vulvitis is most

often the treatment of its chief symptom, pruritus. This symptom is usually spoken of as if it were a clinical entity, but it cannot be too strongly emphasized that it is not, except in those rare cases in which a definite neurosis exists, or in which, as Taussig points out, the primary cause has been removed but the habit still persists. Scrupulous cleanliness is essential, and hot Sitz baths are helpful. Local irritations must be eliminated, proper drainage of the genital tract must be secured, constitutional conditions, chiefly diabetes, are to be corrected, highly seasoned foods and stimulants are to be avoided, and general hygienic measures are to be employed. Local measures to relieve the itching include applications of weak carbolic acid solutions, silver nitrate solutions, lead and opium compresses, or similar measures. My personal opinion is that simple carbolated vaseline or some salve containing menthol gives as good results as any of the more elaborate combinations, especially if friction from clothing or from vulvar pads is eliminated. If these measures fail, local applications of 10 per cent iodine may be tried at four or five day intervals, and short x-ray exposures may prove effective. Following the suggestion of Weiner, I have relieved several cases by repeated infiltrations with novocaine, in a solution of  $\frac{1}{4}$  of 1 per cent, and others with infiltrations of normal salt solution, but unfortunately the good results are not permanent.

Vulvitis in childhood differs from the condition in adults in that it is always associated with vaginitis, and that, if the gonococcus is the cause, as it most frequently is, it can be isolated in the discharge. The youth of these patients complicates the treatment, and the persistence of the organisms in the tissues makes it tedious and trying. Moreover, this disease is highly infectious, and strict prophylactic measures are necessary in the home as well as in institutions if its spread is to be avoided. The treatment consists of full exposure of the parts, preferably in the knee chest position, and thorough

painting of the structures with acriflavine, silver nitrate, mercurochrome, or some similar agent, with due care, of course, that the solution is not too strong for the delicate tissues. Douches of the same sort are given daily when possible. Recently I have been using a solution of 10 per cent mercurochrome put up in sterile jelly, injection of which into the vagina has given me rather good results. Graves advocates treatment by hot air, other authorities believe that urotropin should be given regularly to keep the tissues bathed in a solution of formaldehyde, and still others favor the use of gonorrheal vaccines. With these I have had occasional good results in children, and they are worth a trial since, even though their effect is uneven, at least they do no harm. Unremitting cleanliness is the chief requisite, and this, together with persistence in whatever treatment is adopted, is, I believe, more a factor in the cure than the special method followed.

In short, the treatment of vulvitis of all types is little more than the detection and cure of the causative condition, plus such local measures as will add to the comfort of the patient and will relieve her of the discomfort of the pruritus, which is usually the chief symptom. Acute conditions of gonorrheal origin are best handled by absolute rest. And finally, one must never forget the possibility of cancer of the vulva, which may be overlooked. In this connection a word might be said about leucoplakic vulvitis, which may or may not go on to kraurosis, but which, according to Taussig, although benign in itself, is associated with malignancy in at least half of all cases. X-ray and radium give poor results, glandular therapy cannot be relied on, but vulvectomy is both prophylactic and curative, and no time should be wasted on the trial of superficial measures before this radical one is resorted to.

Chancre plainly demands no local treatment except cleanliness; the cure here depends upon the treatment of the constitutional syphilis. Chancroid, on the other

hand, is amenable to local measures, though healing is often a slow process because of the resistance of the deeper structures. Cauterization by carbolic or the electric cautery probably gives the best results, with the use of antiseptic powders during the healing stage. Diathermy has also been advised. If the inguinal glands are involved, however, ambulatory treatment must cease and the patient must be confined to bed.

The so-called venereal warts which appear on the perineum, the mons veneris, the labia or the mouth of the vagina, are, in non-gonococcal cases, usually due to lack of cleanliness and will disappear without treatment. This is especially true of the type which appears during pregnancy. If treatment is indicated, a strong astringent solution of lead or opium, or some antiseptic powder is usually sufficient, though sometimes they must be cut off under novocaine and the bases touched with carbolic or the cautery.

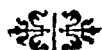
The hymen may be involved in any of the infections and inflammations we have described and the treatment is the same. A special type of vaginismus may be produced by its failure to rupture during coitus, the abrasions and infections which follow the injury in turn producing sensitive granulations. In cases of this sort, after the infection has cleared up, mechanical rupture may be done. Vaginismus may be treated in the office by graduated dilatations, if no local conditions

such as fissures, caruncles, vulvitis, etc. are found to be responsible for it. For true vaginismus psychotherapy is usually necessary.

A thick, fleshy hymen may call for incision and mechanical rupture, but other anomalies of this structure as a rule offer no bar to coitus and subsequent conception, and so demand no treatment. On the other hand, imperforate hymen associated with hematocolpos is a potentially grave condition, and I would utter a very serious warning against attempting its correction anywhere but in the operating theater, under the strictest aseptic precautions. It is the sort of pathology which illustrates perfectly the point I have endeavored to make concerning the limitations of office treatment. On the surface, nothing seems simpler than the puncture of the imperforate structure. Actually, there are few operations in gynecology with greater possibilities of a subsequent sepsis, and here, as in many other cases, judgment rather than skill must decide what can and what cannot be done within the limitations of the office.

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## COLLODION TREATMENT OF BOILS AND CARBUNCLES\*

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**A** BOIL is a local staphylococcus infection in the skin. As the skin is a dense structure and the staphylococcus usually is not a very virulent organism, the result is a limited amount of necrosis and a few drops of pus. These

escape in the direction of least resistance, which is toward the surface.

If the same organism invades the loose subcutaneous areolar tissue, conditions are more favorable for the spread of infection, and there is more suppuration and

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a larger necrotic mass. In order to escape, the products of inflammation must penetrate the entire thickness of the skin, and in doing this they follow paths of diminished resistance furnished by the *arrectores pilorum* muscles, the sweat and sebaceous glands, and the hair follicles. This gives rise to the cribriform openings characteristic of carbuncle.

The difference between boils and carbuncles is size, and this depends on the physical characteristics of the tissue involved. Tissue density is not the only factor. Constitutional states, like diabetes, have their influence on the course of inflammation, but other things being equal, the more compact the tissue, the greater the resistance to extension of infection.

We can render the tissue surrounding a focus of infection more compact by making use of the contractile property of collodion.

The following technic is recommended: The collodion must be contractile, i.e. collodion *u. s. p.* Flexible collodion will not do. The skin should be shaved. If an ointment has been previously used, this must be removed. Gasoline is satisfactory for this purpose. In any case, the final cleaning of the skin should be with alcohol or ether, or preferably both. The collodion is painted in a thick circular band around and on the boil, leaving an opening where it seems to be pointing; or where it is desirable that it should discharge. It is necessary that the band be wide enough to extend beyond all inflamed tissue. It is best that the middle of the band be made thick and tapered toward the periphery and toward the central opening. The collodion is applied by about ten to twenty circular strokes with a saturated swab, so as to build up a thick layer. The completed dressing resembles a thin bunion plaster in shape. The size varies from  $1\frac{1}{2}$  in. with a  $\frac{1}{4}$  in. opening for a small boil to 6 or 8 in. with an opening an inch or more in diameter in a carbuncle.

As the collodion dries, certain interesting

things happen. The pain is relieved immediately, within thirty seconds, and does not recur.

Wrinkles appear in the collodion and extend out on the surrounding skin, showing that the tissue is being pulled together. A profile view shows that there is a considerable projection of tissue through the central opening. If a bunion plaster were placed on the mammary gland so that the nipple projected through the opening, it would give an idea of the appearance. When this protrusion of tissue takes place it shows that the procedure has been properly carried out. After the collodion dries it is covered by a light gauze dressing large enough so that it can be secured by adhesive plaster strips placed well outside the edge of the collodion. In twenty-four to forty-eight hours this central projection breaks down and the slough is discharged, leaving a relatively small cavity.

In the case of a carbuncle the relief of pain is not so prompt and complete, but it is always considerable. It may take a week or more for the slough to be discharged.

In either a boil or carbuncle there is generally such a marked change in a few hours as to suggest that compression of the tissue results in concentration of the contained antibodies (but this is pure speculation).

If the collodion ring becomes loose before the slough has been discharged, the loose portion may be trimmed away and the dressing reinforced by more collodion, or if necessary an entire new application may be made. This should be avoided as much as possible, as repeated applications tend to set up a superficial dermatitis. When two or more boils are close together it is better to surround the group with a single band of collodion.

If a boil is located near the edge of the lip it is not possible to surround it with the collodion circle, but in this case a half circle or horseshoe band is applied. In two of the dangerous upper lip furuncles

the infection did not extend after this procedure was adopted.

There are certain limitations to the usefulness of this method. Boils and carbuncles are usually situated on extensor surfaces where contraction of the skin will exert compression, but if the skin is loose and the contour of the part is concave, as in the axilla, contraction of the collodion will result in gathering the skin together like a purse-string ligature.

In a small series of carefully measured applications the contraction of collodion was found to be quite uniform. The average contraction was 18 per cent in one hour

and 27 per cent in four hours. The extremes were 22 per cent and 32 per cent. After four hours there was very little further contraction.

The advantages claimed are:

1. Prompt relief of pain.
2. There is no incision, consequently no infection of tissue previously uninfected.
3. The surrounding skin is protected so that the primary focus is not surrounded by a secondary crop.
4. The slough is discharged promptly and healing is accelerated.
5. It is not incompatible with other methods of treatment.



## HOW TO REMOVE OCULAR FOREIGN BODIES\*

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THE complaint of "something in my eye" is one that each and every-one of us should appreciate, especially if at some time we have been the victim.

To know one's limitations in a particular subject is better than to "take a chance." The experience gained after treating several thousand of these cases is worth while.

After ascertaining in a brief statement, what happened, place the patient in a chair, with the head rest properly adjusted, or, lacking a head rest, place the chair so that the patient's head rests against the wall. In some cases it is better to have the patient lie on the examining table.

If there is considerable eyelid spasm, which interferes with the proper examination of the eye, instil a drop of some local anesthetic, such as holocaine 1 per cent, or butyn 2 per cent, or cocaine hydrochloride 4 per cent. (Remember that cocaine dilates the pupil and causes a drying of the corneal surface.) This is done by telling the patient to "look up," at the same time pulling the lower eyelid down with the

index finger or thumb of the left hand, by pressing on the skin at the lower edge of the orbit. Instil the anesthetic on the conjunctiva of the lower lid and not on the ball of the eye. This instillation may be repeated, if necessary, at intervals of three minutes, for three doses.

Have a beam of light focused on the eye which you are examining, from a lamp with adjustable goose neck, either attached to the wall or on a floor stand (Fig. 1), placed on the right side of the operator if right handed, and on the left, if left handed. Evert the lower eyelid in the same manner as when the drops were instilled, look at the conjunctiva and give special attention to the lacrymal puncta of the lower eyelid, as it may contain an eyelash or a piece of hair (seen frequently in barbers or after a hair cut). Note whether any of the eyelashes are turned in, rubbing the eyeball. If it is a foreign body, wipe it off with a tooth pick whose end has been wrapped with cotton. If there is a piece of hair in the puncta, remove it with a pair

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of small tissue forceps. Turned in eyelashes are to be pulled out.

To inspect the conjunctival surface of

antiseptic, such as solution of argyrol 20 per cent (freshly made) or solution of mercurochrome 1:500.

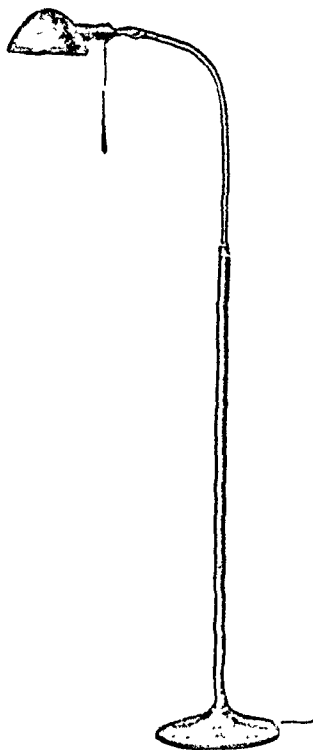


FIG. 1.

the upper eyelid, grasp the eyelashes with the index finger and thumb of the left hand, tell the patient to "look down" and turn it on a cotton wrapped toothpick, at the wrinkle in the skin, which is about  $\frac{1}{4}$  in. back of the edge of the eyelid and which indicates the edge of the tarsal plate. Do not fail to inspect the conjunctiva in the retrotarsal fold which is above the edge of the tarsal plate, by pushing the lower eyelid upward and against the ball of the eye, causing the conjunctiva to come into view. If a foreign body is seen, remove it with a cotton-wrapped applicator.

Direct the patient to apply compresses of cool boric acid solution every three to four hours, for five minutes until the redness and discomfort disappears. If the foreign body has been in the eye for a day or two, there will be some excess mucus or mucopurulent secretion. If so, follow each series of compresses with some



FIG. 2.

If after a careful examination of the conjunctival surface of the eyelids and the lacrymal puncta, inspect the cornea.

Take a magnifying lens in the left hand, between the index finger and thumb, using the other fingers to hold up the upper eyelid and focus a ray of light on the cornea. Examine to see if there is a foreign body present. If one is located, instil one of the anesthetics mentioned and then try to remove the particle with a cotton-wrapped applicator held in the right hand. Direct the patient to keep both eyes open and to look at some object or point so as to keep the eyes steady. Failing to remove the object with the cotton-wrapped applicator, use a blunt eye spud, previously sterilized, and have the blade of the spud nearly parallel with the surface of the cornea. If the foreign body has gone into the eye hot, as from the exhaust of an auto, or from the friction of the tires on the pavement or from an emery wheel, it will leave a dark ring or eschar, which should be removed. This is best accomplished with a foreign body needle, trying to get under or behind it, care being taken not to perforate the cornea, by digging too deeply. The combination of blunt and sharp edged spud can be secured in a universal holder and made of rustless steel (Fig. 2).

After a foreign body has been removed from the cornea, with a cotton-tipped applicator, instruct the patient to use warm applications of boric acid solution every four hours, for five minutes. If the cornea has been badly damaged and the patient is a young person, instil 1 drop of solution atropine sulphate 1 per cent. Be sure to tell the patient that "the

drop will make the pupil large and that the vision will be blurred for a few days."

If an elderly person, with much damage to the cornea, and in whom the use of homatropine or atropine solution might cause glaucoma, it is better to prescribe solution pilocarpine hydrochloride 1 per cent, to be used every three hours, to put the iris at rest.

Treatment with the warm application, and the solutions if necessary, should be continued until all congestion of the conjunctiva has disappeared. It is good plan, unless the foreign body has been wiped off with the cotton-tipped applicator, to have the patient place about  $\frac{1}{2}$  inch of ointment of yellow oxide of mercury, 1 per cent, dispensed in a tube, on the lower lid conjunctiva, after everting the lid, then close the eye and gently massage the eye-ball. The ointment should be applied before retiring.

Cocaine solution, as an anesthetic, should be avoided, especially in a person past forty years of age, because it causes dilation of the pupil and might bring on an attack of glaucoma is one susceptible to this disease.

If, after a careful examination has been made, no foreign body has been found, instil a drop of 1:500 solution of mercurochrome and wash out the excess with a small amount of boric acid solution. Then examine the cornea with a ray of light, focused with the condensing lens. A red spot indicates that the conjunctival or first layer of the cornea has been abraded and the treatment indicated is the same

as when a foreign body has been removed from the cornea.

The use of smoked glasses give relief from the lacrymation and photophobia caused by bright light or sunlight.

The value of placing a dressing and bandage or the use of a black patch to cover the injured eye, instead of the dark glasses, may be determined by the amount of injury of the cornea, the distance that the injured person might have to travel in inclement weather and the general mentality of the patient and the condition of his surroundings. The laborer in the foundry or the steel mill will do better if his eye is covered between treatments to prevent contamination by dirty fingers or soiled handkerchiefs.

In young children it is sometimes possible to remove foreign bodies from the upper and lower eyelids, without much difficulty, but in case the foreign body is imbedded in the cornea, it is safer to administer a general anesthetic than to risk further damage or perforation of the cornea, in attempting the removal in a nervous, frightened and uncontrollable child.

The essentials for the successful removal of foreign bodies from the human eye may be summed up as: (1) a comfortable position for the patient's head; (2) sufficient anesthesia to render the eye insensible to pain; (3) a good beam of light on the injured eye; (4) good vision in the operator's eyes; (5) the proper sterilized instruments, and a knowledge of what to do and how to do it.





# SUBCUTANEOUS FOREIGN BODIES IN MINOR SURGERY\*

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A VERY considerable number of all patients who apply for emergency treatment are victims of foreign bodies. While the injury itself may not be immediately serious we find altogether too often ill-advised emergency treatment administered. Sound judgment and application of fundamental principles of surgery are most important in handling this type of practice if we are to avoid aggravating the pathology already present.

Foreign bodies may be roughly classified into: (a) foreign bodies containing sufficient mineral matter to cast an x-ray shadow, such as steel, certain types of glass, stones, etc.; (b) those foreign bodies which do not usually contain sufficient mineral matter to cast a shadow, such as splinters and vegetable matter.

## A. FOREIGN BODIES IN THE SKIN AND SUBCUTANEOUS TISSUES

In general this foreign material should be removed at the earliest possible moment after its introduction into the tissues. Certain dicta might be outlined:

1. Always study the line of transit of the foreign body through the tissues and localize the foreign body with intelligent use of the x-ray and fluoroscope when possible. Accurate localization of a foreign body facilitates its removal.

2. Operative removal often demands considerable dexterity and ingenuity. The search and removal of the foreign body must be done with the very minimum of trauma, bearing in mind that operation often further disseminates the potential infection that lurks in *all* accidental wounds.

3. The approach to a localized foreign body is usually facilitated by making the exploratory incision at right angles to the long axis of the foreign body.

4. An Esmarch's bandage applied to an extremity gives a bloodless field and far better visibility in dealing with foreign bodies or infections.

5. If a foreign body is small and deeply situated and causing no loss of function, operation is inadvisable as its removal would probably do more harm than good.

6. When the tract of a thorn or splinter is subcutaneous, it is often advisable to open up the tract throughout.

7. Blind search for a suspected splinter is usually non-productive and meddlesome surgery.

8. Removal of powder burns, dirt, sand, etc. Early removal of every particle of such insoluble foreign material is imperative if we are to avoid having them covered over by epithelium. Neglect of early adequate treatment in these cases often leaves permanent areas of discoloration in the skin similar to tattoo marks. Powder grains are so soft and numerous that it is hopeless to pick them out one by one. A thorough scrubbing (under a general anesthetic) with a stiff brush until every trace of the powder and dirt is scraped away is probably the best assurance of a satisfactory cosmetic result.

9. Foreign bodies which remain in the tissues by intent or oversight become encysted in inflammatory reactive processes, i.e., scar tissue. These encapsulated foreign bodies may at any time be the seat of an inflammatory focus which eventually leads to their removal. In other instances the foreign body implantation is associated with pyogenic infection. In the latter instance there is a resulting sinus which closes only when the foreign body is extruded spontaneously or removed.

10. A satisfactory postoperative treatment of these wounds would be that

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applicable to infected wounds in general until they are proved otherwise. Accordingly it would seem rational therapy to order rest, immobilization, sterile compresses, etc. For practical purposes an alcohol and glycerine compress affords an excellent dressing for these wounds.

11. These wounds are often in the nature of puncture wounds and hence are potential seats for anerobic cultures. Therefore we always consider and anticipate the possibility of gas or tetanus infection in each individual case. In such instances the prophylactic serum is always indicated.



## STRICTURE OF THE URETHRA\*

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TRUE stricture of the urethra is a cicatrix of the urethral wall left there by some injury or inflammation, and manifesting a constant tendency to contract, and thus to diminish the lumen of the urethra. This tendency to contraction, which is always manifested in a greater or less degree, is doubtless caused by the irritation incident to micturition; the impact of the stream against the barrier, for the deepest stricture, the one which most obstructs the flow of the urine, is almost always the tightest and if the stricture is kept dilated so as to afford little or no obstruction, the tendency to recontraction is slight.

Stricture occurs in the female as well as in the male urethra. But this lesion in the female is much less common, and manifests no distinguishing peculiarities.

Several classifications of strictures have been offered, but one I like best is to class them as inflammatory, traumatic and inflammatory strictures which have been operated and thereby have had true scar tissue added to them. About 90 per cent of all strictures of the urethra are due to inflammatory causes; 10 per cent are of traumatic origin. Inflammatory strictures are usually multiple, the deepest being always the narrowest. Sixty per cent of all gonorrheal strictures occur in the deep urethra. We find that 64 per cent of all

strictures of the male urethra occur in this portion of the canal.

The formation of inflammatory stricture is of long duration and is an interesting process. The patient contracts the gonorrhea which becomes chronic. After a number of relapses from a chronic to the subacute stage, the tissues become accustomed to the presence and growth of the gonococcus, that they react to its presence only by the formation of a round-celled infiltration of the urethral wall. As the round-celled infiltration progresses the urethral wall becomes thickened, loses its elasticity, the canal is narrowed, and we have the formation of a mass which has been given the name of stricture. In the majority of these cases the mass is palpable. As this process becomes older, connective tissue cells appear in the older portions and the mass undergoes organization, that is, it becomes converted into fibrous connective tissue. This has the nature of all newly formed fibrous tissue and as it reaches maturity it shrinks. This shrinking causes permanent loss of elasticity in the walls of the canal and partial or total obliteration of the canal itself. The thickening in the urethra is not entirely due to organized tissue, but to the completely and partially organized tissue, to which is added an area of greater or less extent of inflammatory exudate.

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When we study traumatic stricture we find an entirely different process. Here we have tissue loss in the urethral wall. We have the space filled first, with blood clot, then with an exudate which becomes organized into fibrous tissue which shrinks. In this way it distorts and obliterates the canal. In this case, however, there is no thickening of the tissues. A scar which binds two torn tissues together is never as thick as the tissue it joins. In the urethra where scar tissue replaces lost portions, the wall is thin instead of thickened. Only occasionally is there an area of chronic inflammation surrounding the lesion, so that in the majority of cases traumatic stricture is not palpable. Those cases which are palpable belong to a class of inflammatory strictures which have been operated on and we have the combination of inflammatory and traumatic stricture.

If we compare sections made from inflammatory stricture and traumatic stricture under the microscope we find they are alike, with the exception that in the tissues of inflammatory stricture are found small foci or islands of lymphocytes. These are more numerous in the newer tissue and finally entirely disappear from the old tissue. Microscopically these tissues are said to be identical, clinically, inflammatory stricture and traumatic stricture differ very much. This difference not being in the symptoms they produce or the length of time which they require for their formation, but in the fact that one permits of cure by dilatation while the other does not.

Dilatation is the accepted method of treatment of urethral stricture today. But indulged in carelessly it has fallen into disuse since it only adds to our troubles. Torn tissues always heal by the addition of scar. Dilatation can be performed in two ways, either by temporary or continuous pressure. The temporary method, that is the passage of a bougie or sound which is allowed to remain for a few seconds to a few minutes, is applicable to a stricture of large caliber. The continuous method,

where the bougie is allowed to remain for a number of hours or days, is suited to use in very narrow strictures of the deep urethra.

If a case comes to us with a dribbling or a retention and we are able to pass a filiform bougie through the stricture, this bougie should not be removed but should be fastened in such a manner that it can neither come out of the urethra nor pass into the bladder. If the bougie has apparently gone through the stricture and we are uncertain that it has followed the urethra, a rotation of the instrument, provided the proximal end of the bougie is in the urethra, will give the patient a sensation of urination and we are then certain that the bougie is within the urethra. At the end of twenty-four hours, or at the most forty-eight hours, we should be able to pass another bougie beside the first, and within the next day we should be able to pass a third. These can be allowed to remain several days longer, at which time we should be able to pass larger bougies without trouble.

In treating all strictures of the urethra one cannot tell just what portion of the inflammatory urethral obstruction is caused by organized tissue, cellular infiltration, or inflammatory exudate. We must add to our mechanical treatments those methods which seem best to relieve inflammatory conditions. Hot applications are the best for the relief of inflammation, and they are particularly valuable in the inflammations in and about the pelvis. This is true both of the female and male patient. We, therefore, add to our mechanical treatment, hot sitz baths, two per day. After enough absorption has taken place in the urethra so that a No. 10 F. or 12 F. bougie can be passed without difficulty the patient may be treated by temporary dilatation, that is by the passage of a sound or bougie every seven days. The sitz bath, however, should be kept up for three or four weeks. By this method we are able to pass a number 10 F. bougie in about a week, and in ten to fourteen days the patient

can be allowed to return to his ordinary vocation.

This method of treatment as described is applicable to inflammatory stricture because the newly formed fibrous tissue of inflammatory origin will absorb or become thinned down and stretched out to give the urethra its full caliber. Whether this is due to absorption and stretching a fibrous tissue, or to the absorption of the round-celled infiltration and inflammatory exudate in the mass, I am unable to say. This same treatment if applied to traumatic stricture is practically without results. The fibrous tissue of true scar tissue does not admit of absorption or of stretching so as to restore the caliber of the canal.

Attempts at stretching traumatic stricture have proved absolutely futile. I am

of the opinion that practically all traumatic strictures must be operated upon, and that the more quickly we give our patient this advice, the more quickly we have him on his way to recovery.

In strictures of the third class, that is, those inflammatory strictures which have been operated upon and which have not received the proper after-care but have been allowed to recontract, the proposition is somewhat different. Here we have an inflammatory tissue which we can absorb and scar tissue which we cannot remove by mechanical means. We have, however, no way of knowing the proportion in which these two conditions exist, therefore, we are justified in these cases in attempting a cure by dilatation, which we may have to lay aside after a few weeks and advise operation.



## ELECTROSURGICAL GYNECOLOGICAL OFFICE PROCEDURES\*

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**E**LECTROSURGERY, the incision, removal, or destruction of tissue by means of a high frequency electric current has simplified and rendered more efficient many surgical procedures. This is true in minor and major general surgery and gynecology.

Many gynecological patients require minor operations, so little incapacitating that they are reticent to entering a hospital. Before the advent of electrosurgery, hospitalization was practically a necessity because of the technical difficulties encountered in handling bleeding incisions without an assistant and hemostats. Many patients object to hospitalization for such so-called minor conditions, others being unable to leave their home or vocational duties.

Electrosurgery has made it possible to perform many of these minor gynecological operations in the office as there is little or no bleeding; the operations are technically easier; they are done under local anesthesia; healing is prompt and painless with soft pliable scars; and small malignant or potentially malignant lesions are removed completely with less danger of metastasis.

1. *Urethral Caruncle and Redundant Urethral Mucosa.* True caruncle is not as common as usually supposed. The marked tenderness of urethral caruncle is so constant as to be almost pathognomonic of the disease. Redundant mucosa is practically painless and, being more common than caruncle, is frequently mistaken for it.

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In treating either condition a local injection of 1 per cent or 2 per cent novocaine is first made inclosing a wide margin beyond the disease, frequently requiring injection all way around the urethral orifice. The caruncle is excised with a strong cutting-coagulating current. Healing is prompt after the film of destroyed tissue comes away in about a week. There is usually little pain.

Redundant mucosa is quickly destroyed by applying the monoterminal heating current directly to the surface using a sharp needle electrode. If the tumor is very thick the needle should pierce the tissue to the necessary depth.

Corbus and O'Connor<sup>1</sup> describe a unique method of treatment claiming that by using their technic there is little possibility of stricturing. I have never seen stricture following the usual destruction with the current.

A thin, flat electrode,  $\frac{1}{2}$  inch long and  $\frac{1}{8}$  inch wide, is placed in direct contact with the mucosa. A slow, biterminal current is preferred as the entire depth of the mucosa should be destroyed. The electrode is reapplied to three equidistant portions of the lumen. No shrinking is immediately appreciable, the bulging meatus showing four grayish-white lines of desiccation with normal mucosa between. Sloughing of desiccated areas takes place in a few days, symmetrical contraction of the scar tissue literally pulling the meatus and surrounding mucosa inward. If the desiccation has been done transversely with the urethral wall no actual contraction of the lumen results.

2. *Venereal Warts.* Local anesthesia is necessary here. The warts dry up quickly under the application of a monoterminal desiccating current. Heating is prompt and without notable discomfort. When the warts are thick or piled up closely together, making a bulky dehydrated mass after treatment, they are removed with a curet, the base being

re-dried with the current. Small warts after being treated are allowed to remain until they separate spontaneously allowing healing processes to continue beneath them.

3. *Cysts.* Bartholin's glands cysts are opened with the cutting current with very little or no bleeding. After evacuation of the contents the epithelial lining is destroyed with a desiccating current and the wound allowed to granulate after the destroyed tissue has sloughed. In large cysts frequent packing with iodoform gauze is helpful in keeping the wound clean, stimulating healthy granulations.

4. *Infections in Skene's and Bartholin's glands* causing recurrent infections in the urethra and cervix are frequently obstinate to usual treatment. The glands are easily sterilized by the method of Corbus and O'Connor. A long, thin needle is inserted to the depth of the gland, the current turned on and continued until the tissues adjacent are blanched, indicating dehydration. The dehydrating current produces sufficient heat to sterilize the infection. Healing is prompt and complete.

5. *Endocervicitis.* Chronic endocervicitis is a very common gynecological condition quite resistant to the usual chemical method of treatment. The large edematous cervixes with many large cysts filled with mucopurulent material require thorough cauterization, destroying the deep-seated organisms buried in the long racimose glands. Such treatment should be thorough and extend up to the internal os. Except in a few patients where general anesthesia is contraindicated, these large edematous cystic cervixes should be treated under general anesthesia. In the more mild cases the canal and external os is cleaned up with a biterminal current under local anesthesia. The current should be of comparatively low voltage and high amperage. Too high voltage will cause the current to penetrate far out into the tissues beyond the area of anesthesia giving pain. A short thick spark will destroy the mucosa and glands deeply enough to sterilize without

<sup>1</sup> CORBUS, and O'CONOR, *Diathermy in the Treatment of Genito-urinary Disease*. Bruce Pub. Co., 1929.

general anesthetic. If desirable, the treatment may be done at several sittings.

6. *Polyps.* Small vaginal or cervical polyps are readily destroyed with a short, thick monoterminial current. Pedunculated ones should be grasped in a clamp and the pedicle severed with a cutting current. Very little bleeding occurs, prompt healing being the rule.

7. *Hemorrhoids.* Much has been written recently about the destruction of hemorrhoids with electrosurgical currents. Suffice it to describe here those which are most readily treated in the office. It should be noted in passing that large internal and external hemorrhoids can be dehydrated (desiccated) under local anesthesia in the office. Extensive cases should be dealt with in the hospital but there are many patients having small enlarged hemorrhoidal veins which can be relieved by electrosurgery under local anesthesia. Especially is this true with patients who cannot conveniently leave their occupation for hospitalization. Ordinarily one treatment is sufficient but more than one sitting may be necessary when several hemorrhoids exist.

One or two hemorrhoids require only

local injection about them whereas multiple ones necessitate injections around the anus and up above the internal sphincter. The sphincter muscle is then dilated, releasing the spasm, which causes the hemorrhoid. A desiccating monoterminial current of short, thick spark is preferable being applied by a suitable needle electrode. The needle is thrust into the hemorrhoid and allowed to remain until the blood is dehydrated sufficiently by clot. There is, also, a small area of whitening around the point of insertion. William L. Clark advises no further treatment but Kelly and I feel that it safeguards against possible infection by incising the vein wall for subsequent drainage. The clot may be vaccinated if desired.

Larger hemorrhoids require clamping with any suitable hemostat stagnating the blood rendering dehydration and clotting more prompt. When the clamp is removed no hemorrhage occurs.

Healing is usually complete in two to three weeks with little scarring or pain. Occasionally pain does occur being readily controlled with mild sedative suppositories or instillations of sedative solutions.



## INJECTION TREATMENT OF VARICOSE VEINS\*

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THAT veins could be obliterated by the injection of sclerosing solution into their lumen has been known for a long time. Many physicians have noticed this phenomenon, always with more or less fear and trepidation, in the therapeutic administration of drugs intravenously for other purposes. However, until the past few years it was thought to be unscientific, in fact foolhardy, to introduce a solution into a vein with the intent purpose of forming a thrombus. The possibility of the occurrence of a

pulmonary embolus seemed to be too great to give this a second thought as a therapeutic measure. Yet McPheeters and Rice in reviewing 53,000 cases of varicose veins treated by the injection of sclerosing solutions into their lumen found only 4 authentic cases of pulmonary embolus. These same men have shown by injecting lipiodol into varicose veins of the lower extremity and observing the direction of flow under the fluoroscope, that the flow is toward the periphery in the superficial varicose veins and not toward the

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heart, as we might expect. This is due to a dilatation and incompetency of the valves of the saphenous system, and as a result the blood stagnates in the lower portion of the leg. If an embolus is formed it will travel toward the periphery and lodge in one of the branches of the vein rather than proceed through the heart to the lungs.

#### CONTRAINDICATIONS

As more has been learned of the injection method of treatment the contraindications, which were at first thought to be numerous, are now recognized to be few indeed. Where there is a definite etiological factor present this should be corrected first, if possible, before we can expect progress very far with the treatment of the varicosities already present. With the etiological factor removed we can then proceed with the injection, knowing that new varicosities will not be formed as soon as those present are obliterated. We believe that this method is contraindicated in definite cases of cardiorenal disease and in the aged and decrepit. A further contraindication is the presence of a superficial infection of the veins of the leg and again a history or evidence of a preceding thrombophlebitis of the veins of the deep system.

#### SOLUTIONS

The solutions used for producing the sclerosing effect on the vein wall have been numerous. Our experience has been limited chiefly to the sodium salicylate in 20, 30, and occasionally 40 per cent and to the invert sugar in 60 and 75 per cent strength. The sodium salicylate requires greater skill on the part of the operator and a more exacting technic, for if any of this solution is deposited extravenously it will not only cause severe burning pain to the patient but will also produce a slough of the injected tissues. It has the further disadvantage of causing a very intense cramp-like pain at the time of injection lasting from one to three minutes, which

occasionally is so severe as to cause the patient to cry out in agony. However, the salicylate is extremely effective in obliterating the vein and superior to the invert sugar in this respect. On the other hand the invert sugar will not produce a slough if only a few drops are deposited extravenously but will cause a periphlebitis which, while painful, is not alarming. It generally causes a mild cramp at the time of injection, but this is not to be compared with the agonizing cramp from the salicylate. However, the invert sugar solution will sometimes have to be used two and even three times in the same vein (the large leathery type) particularly if the technic has been such that the solution has been injected into a vein partly filled with blood, thus causing a dilution and loss of effectiveness.

#### EQUIPMENT

The equipment necessary for the injection is simple. It consists of (1) the sclerosing solution to be used, which can be obtained in ampules; (2) a 10 c.c. Luer Lok syringe; (3) a large long needle used only for filling the syringe with the solution; (4) a fine, sharp-pointed, short-beveled needle for entering the vein; (5) rubber tube tourniquets, and (6) ordinary gauze bandage, adhesive tape, cotton and alcohol.

The aim and object of the operation is to inject the solution into the lumen of the vein in sufficient concentration to cause a definite thrombophlebitis, eventually resulting in organization and obliteration of the vein. It is also our object not to interfere with the circulation in the deep veins. Our technic has been devised with these objects in view.

The patient is asked to remove all clothing from the lower extremity. We then have him stand in the step of an ordinary examining table. This causes the varices to be distended and dilated so that they can be entered easily. Having previously filled the syringe we change the needle so that the needle we now use has none of the solution on its outside, as

this would be sufficient to cause irritation along the line of puncture. We then place a tourniquet about 3 inches below the site selected for the injection, making it tight enough to shut off only the superficial veins. Using the strictest aseptic technic we enter the vein. After we are sure that the point of the needle has entered the vein we push the point forward in the direction of the course of the vein for a distance of  $\frac{1}{4}$  to  $\frac{3}{8}$  inch. If this is done a slight movement on the part of the patient or a slight shakiness on the part of the operator can not cause the needle to slip out of the vein. With the needle still in the vein's lumen and before any injection is started we have the patient lie down in the horizontal position. While the operator holds the syringe with the needle in the vein an assistant carefully raises the leg to about 2 feet above the horizontal. The vein will then empty itself of blood by gravity and collapse. With the leg still in this position a second tourniquet is placed around the leg about 3 inches above the site of injection, care being taken to shut off only the superficial veins. The vein is now collapsed and segmented by tourniquets above and below. We then aspirate to make sure that the needle has not slipped out of the vein during the manipulation of the leg. If we are still within the lumen we begin injection. The injection can proceed as rapidly as is expedient, but one thing is absolutely essential, i.e. that we be sure that we are within the vein at all times during the injection. The amount injected into each vein varies with the size of that particular vein. We usually inject sufficient solution to cause a moderate distention of that vein, whether it be 5, 10, 15 or 20 c.c. When the injection has ceased we do not immediately remove the needle from the vein but allow it to remain in situ for from three to five minutes while the sclerosing solution is exerting its effect. The tourniquet can then be released and the needle withdrawn and pressure applied directly over the needle puncture. This will prevent leaking of the fluid into the tissues. We may

inject two or three veins on each leg with the sugar solution at each sitting, but it is not believed wise to inject more than two veins at one time with the salicylate.

As to the frequency of injections it is probably best to wait about ten days between treatment. This will allow time to observe the effects of the previous injection and we are then better able to judge the necessity for further injections. In less time than this we will be unable to tell what veins have been sufficiently affected by the solution to be obliterated. A good injection into a large varix will frequently obliterate most of the smaller tributary varices in this segment, thus obviating the necessity of injecting them separately.

Some operators have felt hesitant about injecting the saphenous vein high up in the thigh, contending that embolus is more apt to be dislodged in this region. In view of the before-mentioned work of McPheeters and Rice, this does not seem to be a logical contention and the saphenous vein can be injected close to the femoral opening with as much assurance of safety as elsewhere in the leg.

After a proper injection there will be slight inflammation and redness along the course of the vein. This will cause some inconvenience to the patient for two or three days but nothing more. If any of the solution is deposited extravascularly a severe periphlebitis and paraphlebitis will occur, and if much is deposited a slough will be produced. At the end of two weeks the vein can be felt as a fibrous cord running up the leg. However, organization will not be complete for from sixty to ninety days.

#### RECURRENCE

Many patients ask the question, "Doctor, will these come back?" We can tell these patients with a fair degree of assurance that the ones injected and obliterated will not come back. However, we must explain that the mere injection and obliteration of the veins already present will not



prevent the formation of new ones and there will be the same tendency to form new ones as there was to form the original ones. For this reason the patient should

report for observation at least once a year after he has been discharged, at which time all newly formed varices can be taken care of at one sitting.



## TREATMENT OF FRACTURES OF FINGERS AND TOES\*

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AS the anatomical characteristics of the bony structures about the toes are for all practical purposes the same as the fingers a single classification of the types can be made. From a functional as well as a cosmetic standpoint, however, the treatment of the finger fracture is more important than the toe fracture. We will write of all of the injuries as fractures of the fingers but the same treatment can be applied to like fractures of the toes.

The fingers as well as the toes consist of three phalanges with their attached and associated muscles, tendons and joints, with the exception of the thumb (analogous to great toe) which consists of only two phalanges and whose function is more highly specialized than the rest of those small structures. The most simple as well as general classification of the fractures is as follows:

1. Chipping and comminuted fractures of the spongy portion of the distal phalanx.
2. Transverse fractures of the shaft.
3. Spiral fractures of the shaft.
4. T-fractures into the joint.
5. Tearing loose of the tendon insertions.

Any of these types can be compound rather than simple.

Practically all fractures are treated in our office under local anesthesia, using the technic taught by Prof. Lorenz Boehler of Vienna. This consists of the painting of the skin over the site of fracture with iodine followed by alcohol. A sterile needle is then introduced between the fragmented bone, care being used to get this

into the hematoma produced at the time of injury. Then about 5 c.c. of 2 per cent novocaine without adrenalin are injected through this needle directly into the hematoma, which is in this way the carrying agent as well as the dispersing of the anesthetic. After a short interval of time (depending on the age of the fracture) manipulation can be carried on painlessly. In compound wounds the injection should be made on the opposite side of the compound wound and a through debridement of the wound with closure of the skin made. Fracture of the digits can also be done under a nerve-block anesthesia of the lateral nerves but we have found the direct local to be the simplest as well as the most efficacious.

Chipping and comminuted fractures of the spongy portion of the distal phalanx are usually associated with some hemorrhage under the finger nail. In order to relieve the tension and pain caused by this condition the nail is opened widely to permit of drainage (no anesthesia is used); the fragments are moulded into good position by direct pressure, and a small tongue depressor splint, from the proximal interphalangeal joint, so that it projects well over the tip of the finger, is bandaged in place. The bandage can be changed as necessary with the splint allowed to remain in place about three weeks and the patient allowed to use his finger. He may be discharged in one month.

Fractures of the middle of the shaft of the distal phalanx are associated with

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some displacement but not with the deformity due to muscle pull. These fractures can be injected with the local anesthetic, a primary reduction by manipulation and traction and a small tongue depressor splint applied on the flexor surface so that it immobilizes the distal interphalangeal joint.

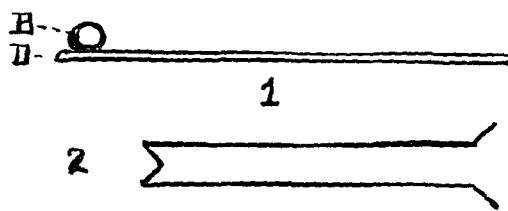
In traumatic work we often come in contact with a case which has received either a direct blow, a forcible flexion or extension of the distal phalanx. These cases show an immediate droop of the distal phalanx into flexion. The x-ray will reveal a small chip fracture of the proximal end of the distal phalanx at the insertion of the extensor tendon. The end-result in these cases, in practically all instances, is permanent deformity of the distal interphalangeal joint with some loss in extension. Occasionally by moulding and counter-pressure over this area together with a palmar splint along the whole of the finger, the detached piece can be replaced. It is usually well to put a piece of hard roller bandage on the distal end of the splint and by adhesive hold the distal phalanx in shape extension as shown in Fig. 1.

The splint in this condition, however, must be allowed to remain in place about four weeks and one should not be surprised if the flexion deformity recurs on its removal. We have practically never opened up one of these cases to tack the tendinous insertion in place.

T-fractures into the joint can all be very effectively and practically reduced under local anesthesia. Small appropriate splints are used to hold them in place, keeping in mind, however, the value of early motion for restoration of function. In our practice we begin this passive motion in ten to fourteen days and replace the splint until about the seventeenth to twenty-first day. These fractures are associated with somewhat longer disabilities and as an end-result some slight impairment in motion due to intra-articular deposition of callus is likely.

Spiral and oblique fractures of the shaft,

either of the middle or proximal phalanx, are associated with deformity and shortening due to muscle pull. They are very



FIGS. 1. and 2. B, bandage. D, depressor.

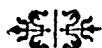
difficult to hold in position after their reduction, which is always done under a local anesthesia. A glue is made of acetone and celluloid so it is of a fairly thick consistency, and by means of this we are able to attach bandage to the finger for traction. A plaster collar is put on over the wrist and in which we incorporate one strand of piano wire bent as shown in Figure 2. By means of heavy rubber bands attached to the plaster and which can be twisted to make traction, the fragments can be held in excellent position and alignment. The whole is covered with a bandage and allowed to remain in place for a period of three weeks when removed. Active and passive movements with heat and massage instituted, recovery takes place in six weeks with small functional impairment aside from the bony thickening at the site of injury.

Fractures of the proximal or base phalanx, whether treated by traction as given here, or any other method, are all held in retentive apparatus in some degree of flexion at the metacarpophalangeal joint due to the anatomical attachment of the muscles. The lumbricales are inserted at the proximal end of the middle phalanx, hence when the finger is dorsal to the midline they extend the middle phalanx on its corresponding proximal phalanx, and when the phalanx is ventral to the midline they act as flexors of it. The interossei, however, at their attachment at the proximal end of the base phalanx always act as flexors of this phalanx. Therefore any fracture distal

to the insertion of the interossei and proximal interphalangeal joint is associated with palmar angulation at the site of fracture. By dressing this type of injury in flexion we relax the interossei muscles and thus relieve our oppositive action. After anesthetizing these fractures with our local anesthetic, acutely flexing the proximal phalanx, we are often able to obtain a 100 per cent result without the

use of traction. They can then be dressed over a roll of bandage in the palm of the hand for three weeks, when they should be released and active and passive motion started. Recovery is usually complete after six weeks from date of injury.

The writers appreciate the fact that there are many important features of these cases which they have not dealt with completely in the small space allotted



## SIMPLE BALANITIS\*

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HAVING made the diagnosis of simple balanitis, the next step is gently to clean the surface and follow this with some mild antiseptic. One of the most dependable treatments is the constant moist dressing: A thin layer of cotton or one thickness of a gauze bandage is moistened with a mild antiseptic and placed over the glands in a smooth layer and the foreskin replaced. The dressing should be changed several times a day (i.e. at each urination). Thiersch solution,<sup>1</sup> or 1:4000 or 1:8000 bichloride solution are examples of well-tried remedies.

If there has been too long a delay in beginning treatments, the surface may be painted with rivanol 1:1000 or 1:2000, or

<sup>1</sup> Thiersch powder: 1 part Ac. salicylic  
7 parts Ac. boric.

Thiersch solution: Thiersch powder 4.  
Aqua 500.

mercurochrome 2 to 8 per cent followed by a constant moist dressing. After the acute infection has been cured, it is well to follow by dusting once or twice a day with zinc stearate or some bland dusting powder.

If the foreskin cannot be retracted, the glands may be cleansed by using a hand syringe with a suitable nozzle or an irrigator under low pressure and a glass tip that will enter without blocking using a mild permanganate of potassium solution, rivanol or mercurochrome solution 1:1000 or 1:2000.

If there is not a prompt response and the foreskin cannot be retracted, a circumcision should be performed, making a dorsal slit in order thoroughly to disinfect the parts and then finish the circumcision and treat the balanitis openly.

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# DIRTY WOUNDS\*

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## INTRODUCTION

THIS brief and dogmatic paper is intended to show how fresh dirty wounds should be cleansed and treated in the physician's office, often distant from centers of population and limited in facilities. The writer does not pretend to add any startling improvements to an old subject but simply to emphasize certain methods and rules which have proved valuable in the writer's association and experience with a clinic treating a large number of injured people. It is not within the scope of this paper to exhaust the particular aspects of treatment in wounds of various types or to discuss the abundant literature on the subject.

## PRELIMINARY CARE OF THE PATIENT

Reassure the alarmed and wounded patient, gain his confidence, make him as comfortable as possible, remove sufficient clothing to expose the wound freely and allow for proper dressings to be placed. For most wounds, make the patient lie on a dressing table, as he often faints and falls at the sight or pain of a trivial wound under treatment. If the injury is large, painful or serious, if shock, fright, hemorrhage or restlessness is present, quiet the patient with morphine (the Mulford type of tube being convenient for this purpose). Laymen should be excluded from the treatment room as they only handicap operator and patient, and create disturbance. A good nurse is invaluable. Be swift but orderly in your procedure, and take charge of the situation at once. The earlier you start treatment after injury, the better is the result and the less the danger of infection. First then, remember you are treating a whole human being, not simply an isolated wound.

## PRELIMINARY CLEANSE

Green soap and warm water serve to cleanse the wounded surface and an adjacent area sufficient to allow for proper treatment and dressing fixation. The scrub must be thorough. A brief foot or hand bath of warm water mixed with green soap and lysol is effective for dirty wounds of extremities; it softens foreign matter so it can be easily removed, also green soap in itself possesses antiseptic qualities.

## SHAVE

You can become skillful enough with an old fashioned razor to shave out only the extreme wound edges without inflicting pain, but also a large enough adjacent area to allow dressing fixation and to prevent wound contamination by hair and skin debris. Dry the parts with sterile gauze.

## DEBRIDEMENT AND EXPLORATION

This means removal of *all* foreign matter and traumatized tissue from edges and depths of the wound. A tourniquet is seldom necessary but can be used to advantage in a finger injury where blood obscures the field and hampers identification of debris and structures. Aside from obvious dirt and hair, all traumatized or devitalized tissue such as fat and skin fragments must be removed, by extraction, curettage, excision or irrigation. Cut away and shape dirty and rough skin edges to allow neat closure. Identify all structures and layers; if necessary, enlarge the wound for proper exploration débridement and repair. Look for injured bone, vessel, nerve, tendon, muscle and sheath, and after the wound toilet restore the anatomy as nearly as possible. Débridement is essential for prevention of subsequent infection; it must be done gently, quickly and thoroughly. In puncture wounds (espe-

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cially of feet) cut away the sealed lips of the wound, curette the tract clean of all loose tissue and dirt, cauterize the tract with carbolic acid on a toothpick swab; insert a small braided silk wick. Then tetanus antitoxin will often be unnecessary, provided the wound is dressed the day of injury.

In connection with débridement, to prevent pain (with or without the preliminary morphinization) use 1 per cent or 2 per cent novocaine. Of course, in small contused wounds there is often sufficient numbing of sensation so that the wound can be treated without undue pain or necessity of novocaine. For the other and larger wounds, prepare the surrounding skin with tincture of iodine and alcohol, avoiding the fresh wound itself, then inject novocaine intradermally and subdermally *around* the wound, or use a nerve block anesthesia in an extremity (e.g. finger). The local anesthetic is thus introduced through an undamaged and surgically prepared surface instead of through the dirty wound, which may then be treated painlessly and doused with antiseptic before repair.

#### CONTROL OF HEMORRHAGE

If bleeding is profuse, control at once by pressure, elevation rest and morphine, by tourniquet, or clamping the "bleeders." Hemorrhage must be controlled at the latest before wound closure, as a hematoma or "wet field" invites infection and delayed or faulty healing; there is also the danger of late or secondary hemorrhage when the patient is out of your reach. Use plain catgut ties or deep skin tension sutures.

#### DRAINAGE

If slow oozing is expected, use a small drain (silk, silkworm gut, gutta percha or rubber-dam) placed according to the size of the wound to allow dependent drainage from the wound depths for the first thirty-six hours. We use drainage for prevention of infection only when there is delay in starting treatment (two to three hours

after injury), or in case of a wound so grossly dirty and traumatized that not all devitalized or foreign matter can be removed without too great sacrifice of tissue. Thirty-six to forty-eight hours tell the story as to whether drains can be removed and healing by first intention expected.

#### ANTISEPTIC AGENTS

In our experience, thorough cleansing with green soap and water, shave and débridement followed by dousing of the wound with freshly prepared tincture of iodine has given the best results, i.e. the minimum of subsequent infection as compared with the use of other measures and other antiseptics. The few cases of infection following this régime are attributable to excessive trauma and tissue devitalization, excessive dirt, or delay in initiating proper treatment. We have lost faith in the use of acriflavine, mercurochrome, hexylresorcinol and the other widely used weaker antiseptics for any but surface wounds, though we use them for superficial lacerations or abrasions where the painful iodine can be legitimately avoided. In scalp or face wounds, avoid burning the eyes or mucous membranes with strong antiseptics. With compound skull wounds (seldom treated except in hospital) we use great precautions: the whole scalp is shaved, scrubbed with green soap and water, flushed with sterile water, dried, wiped with ether, then prepared with tincture of iodine and alcohol; this procedure is simple, quick and effective. We use a solution of ether and iodoform (ether 59.15 c.c., iodoform 5.53 c.c.) in a compound skull fracture wound, drenching it freely after débridement. The dura when covered by sterile gauze is not harmed by this fluid. Phenol in puncture wounds has been mentioned before.

Dakin's solution is an excellent antiseptic for wound irrigation, when it is freshly and carefully prepared, but can not be available or suitable for most offices. Dichloramine-r in oil is excellent,

if prepared by a good pharmacist; it is stable, suitable for office use, but more applicable to the already infected and deep open wound.

#### REPAIR

This is mentioned, though somewhat out of the scope of the paper. After wound preparation, each damaged structure is repaired to restore anatomy and function of the part. Use absorbable and interrupted sutures in these dirty wounds which are potentially infected. In tendon or nerve repair, where strength is essential, silk or linen must be chanced and brief drainage allowed. In our clinic we are accustomed to close all wounds after the careful preparation given here; others of you may prefer to drain more often and widely, using secondary closure when infection or its danger is past. Speed, gentleness and skillful approximation of tissues add greatly to the prospect of good repair and escape from infection.

#### DRESSING AND AFTER-CARE

Use a soft, firm non-constricting dressing of sterile gauze, as small as possible but adequate for any expected oozing; fix with narrow adhesive strips over the gauze or bandage. Avoid collodion dressings, especially on scalp wounds, as they seal exudate and form an ideal culture media for bacteria. Elevation, immobilization, rest and warmth aid nature in preventing hemorrhage and infection, also

promote repair in the early stages of wound healing. Give a protective dose of tetanus antitoxin (1500 units) if there is any question of wound contamination with street dirt or soil, in a dirty puncture, or for severe head wounds. Initiate Pasteur treatment (e.g. the 14 dose Cumming's modification of antirabies inoculations) if there is any question of a rabid animal bite. Be sure your patient takes away medicine (as codeine or aspirin) to tide him over the first hours of discomfort. Before he leaves your office ascertain that he is prepared for comfortable transportation to his destination.

#### SUMMARY AND CONCLUSION

The following points are emphasized in their order of application for the treatment of fresh dirty wounds in the physician's office: Green soap and water, mechanical cleanse of the wound and its neighborhood, shave, local novocaine if indicated for a painful wound, thorough exploration and débridement, control of bleeding, antisepsis, repair, drainage, dressing and after-care. Scrupulous practice of these details is rewarded by healing *per primam* in a very large percentage of originally dirty and potentially infected wounds.

The writer in his association with Drs. C. R. G. Forrester, H. C. Lyman, and D. R. McLean is indebted to them for their example and aid in proving the efficacy of these rules of treatment.



## SCALP BURNS IN WOMEN\*

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THIS article deals with a discussion of burns of the scalp, caused principally by permanent waving of the hair. Due to the present vogue of waved hair and the age-old attitude of women to

be "in style", regardless of price or personal risk, the problem of injuries received during permanent waving has become of increasing surgical importance.

This series comprises the observation of

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19 cases of burns of the scalp seen during the past year and a half, 15 of which were treated by the writer; the observation of the remaining 4 cases was confined to an examination after the burned area had entirely healed.

The burns were all in women between the ages of nineteen and fifty years, with an average of about thirty-six years. Most of them were housewives but several were otherwise occupied, as stenographers, dressmakers, a nurse, etc. These women all received their injuries in hairdressing establishments or beauty parlors and the burn occurred in all but one case during the permanent waving of the hair. The remaining patient was burned by a hot iron while having a marcel wave. The cases came from 16 different establishments. Only two shops had more than one case, one having two, the other three.

According to the patients' statements the burns were thought to be due to excessive heat in 18 cases. In 16 cases the patients informed the operator of excessive heat and pain in the scalp. It is interesting to note that in only 4 of these were the complaints heeded, that is, the apparatus was turned off immediately and the area investigated; in 2 cases the complaints were partially heeded, i.e. the heat was turned off but the area was not investigated and the heat was resumed; and in 10 cases the complaints were entirely unheeded, the heat being allowed to remain on the required length of time. In one case the felt pad under the heating unit, which is supposed to protect the scalp, was actually charred. Two patients blamed their burns on inexperienced operators. In these cases the operators were students. The permanent waving during which these burns were received was done by regular operators or hairdressers in 14 cases, by the proprietor himself in one case, by students in 3 cases and undetermined in one case. In 5 cases the burns were acknowledged by the operator at the time. In 2 cases they were partially acknowledged, that is, some mention was made of a "red spot" on the

scalp. In the remaining 11 cases, however, the burns were not acknowledged. This seems very negligent and very likely was in many cases but I believe that it is only fair to bear in mind that first and even some second degree burns are not all apparent immediately after the receipt of the burn; also that after the rather strenuous treatment which the scalp receives during any permanent wave that it would naturally be slightly hyperemic in appearance and probably more sensitive than it normally is.

In 10 cases the patients received no advice or treatment for their burns before leaving the hairdressing establishments. Eight cases were, at some time, advised or treated by the establishment, 2 of these being delayed several days, while one case was undetermined. The treatment consisted in the application of an ointment in 5 cases, oil in one, vaseline in one, collodion in one, a current of cold air in one, a shampoo in one, and advice against the use of a comb over the burned area in 3 cases. It is the opinion of the writer that there is no first-aid treatment that could be administered by the beauty parlor or by the patient which would do any good and practically all that has been done, as already described, is harmful. We will see under Treatment that any ointment or oily substance is harmful as it aids in defeating the entire principle of treatment. The opinion is, therefore, that the operators or proprietors of the hairdressing establishments should administer absolutely no treatment for the burns. It will give both the operator and the patient a false sense of security if any such treatment is carried out. Eleven of the patients did not treat themselves and 7 did, while one was undetermined. One of the 7 was treated by a nurse and the others applied ointments, vaseline and various concoctions.

Two of the cases were seen by the writer on the day the burns were received and a total of 9 were seen during the first week. The longest interval was ninety days with an average of thirteen days.

This delay, of course, made the proportion of infected cases much higher and was responsible in most cases for the resulting scar and hair loss. Eleven patients had not been under the treatment of any other physician before coming under the observation of the writer, 4 had had professional treatment before and 2 after. The number of treatments per patient by other physicians varied from 1 to 14 with an average of about 5 visits. The treatment by other physicians consisted partly in the following: The hair was clipped in only 2 cases, one at the request of the patient; in one case the doctor advised shaving over the burned area which the patient refused to have done; scabs were removed in one case; ointment prescribed in one, oil in another, boric acid in another; and in one case the patient was advised over the phone, the physician not having seen the burn. Adequate treatment of 16 of the cases was delayed; there was no delay in 2 and one was undetermined. Of the 15 cases treated by the writer, the treatment in only 2 cases was not delayed, that is, these 2 patients came for treatment on the day they received the burn. The remaining 13 were delayed. The number of days before putting themselves under the writer's care varied from none to ninety with an average of 11.6 days.

*Symptoms.* The patient's complaints were as follows:

1. Pain in all 19 cases.
2. Swelling in 10 cases (local).
3. Swelling of neck in 4 cases (regional adenitis was present in 4 cases, 2 anterior and 2 posterior).
4. Swelling of face in 1 case.
5. Earache in 1 case.
6. Fainting in 1 case.
7. Purulent discharge in 1 case.
8. Unsightly appearance in 1 case.

*Diagnosis.* We are dealing with burns of the scalp, the burning of the hair being a factor in only a few cases. The total number of burns in 18 cases was 47, one case being undetermined. The

average was 2.6 burns per patient. In 10 cases the burns were single (55 per cent of the cases) and in eight (45 per cent) the burns were multiple. This emphasizes the importance of not overlooking any burned areas, as the patient may complain of one burn and have several others in other regions of the scalp which may not at the time cause any symptoms. The reason why these burns are liable to be multiple lies in the structure of the permanent wave machine. A short description of the machine will facilitate the understanding of the occurrence of these burns and why they are often multiple.

A permanent waving machine is made up of several dozen units attached to a central source of heat. Each unit is a cylinder with a rod running through it. The hair is wound tightly around this rod and the cylinder clamped around the rod. A felt pad is placed between the scalp and the unit to protect the scalp from the heat and the waving agent. The wound hair in the cylinder is moistened by a solution known as the waving agent and then steam is introduced into the cylinder. This procedure is repeated, using a small amount of hair to each unit until the entire scalp is covered. The waving agent in a majority of cases contains ammonia. The strength and quantity of the solution, as well as the amount and degree of heat, vary with the texture of the hair and the age of the individual. All of the solutions are alkaline. That is one reason why the use of tannic acid in the treatment of scalp burns caused during permanent waving is particularly indicated as it tends to counteract the effects of the alkali as well as to treat the thermic burns.

The parietal regions were most often affected, with 15 burns; occipital, 11; frontal, 10; temporal, 2; and one case undetermined as there were no scars at the time the case was examined. A more detailed delineation to show the distribution of these burns is as follows:



	Burns
1. Frontal (unspecified)	5
2. Right frontal	3
3. Left frontal	1
4. Left temporal	2
5. Parietal (unspecified)	6
6. Right parietal	2
7. Left parietal	3
8. Midparietal	4
9. Occipital (unspecified)	7
10. Left occipital	3
11. Mid occipital	1
12. Undetermined	1

Only one burn was first degree; 4 were first and second degree; 13 were second degree; one was second and third degree; none were third degree alone, and one was undetermined.

The size of the burns on first examination varied from  $\frac{1}{8}$  inch in diameter to  $1\frac{3}{4}$  inches in diameter. The average diameter was .69 inches, or nearly  $\frac{3}{4}$  inch. The total area of the 47 burns was 29.1 sq. in., the average area per case being 1.61 sq. in. and the average area per burn being .61 sq. in.

*Treatment.* Referring to the technic used in the cases which came under the writer's care (this will be described later in detail), 6 cases had the usual technic; tannic acid was used in 3; debridement under ethyl chloride local anesthesia was done in 3, and poulticing was used in 6. The total number of treatments by the writer in his 15 cases was 88, varying from 1 to 11, with an average of 5.86 treatments. The total number of treatments in 9 cases treated by other physicians both before or after the writer's treatment was 61, varying between 1 and 14 with an average of 6.77 treatments.

*Morbidity.* This refers to the number of days from the day of injury until the burned areas are entirely healed and require no further treatment. The morbidity varied from seven to one hundred twenty days with an average of 35.9 days. Considering only the writer's 15 cases the average was 37.6 days.

Ten of the cases were completed and followed to determine the presence or absence of permanent defect, 3 were partially followed; one was not followed;

3 were only examined after the burns had healed, and in one case a follow-up was unnecessary (clean case).

Some disability was suffered in all cases. Those that were employed lost time from work, either because of the pain or because of their appearance. This partial disability varied from one to thirty days with an average of about thirteen days.

*Infection.* Fourteen cases were infected, or 73.6 per cent, and 5, or 26.4 per cent, were not. Of the 15 cases treated by the writer 11 were infected before their first visit and 4 were not. None of these 4 became infected. These were cases that had not delayed treatment too long, 2 were seen on the day the burn occurred, one the following day and the other three days later. There were no permanent defects in these 4 cases. Thus the opportunity for the ideal treatment was offered in only 4 cases.

*Results.* Eleven of the patients or 58.8 per cent, had a permanent defect, 4 did not have a defect; 2 would probably not and 2 were undetermined.

There were resulting scars in 13 cases, 2 would probably not be permanent; 4 cases healed without any scar; 2 were undetermined, and one would probably not have a scar. There was an area of permanent hair loss in 10 cases; none in 6; 2 were undetermined, and one would probably not have hair loss. The size of the resultant scars varied from  $\frac{1}{8} \times \frac{1}{16}$  in. to  $\frac{7}{8} \times \frac{3}{4}$  in. The largest measurement was  $1\frac{1}{4}$  in. The average diameter was  $\frac{5}{8}$  in. The total area of scars in the 11 cases was 2 sq. in. The average area was  $\frac{1}{6}$  sq. in.

The scars were well distributed throughout the scalp, one in the frontal region, one temporal, 4 parietal and 5 occipital.

The detailed areas were:

	Cases
1. Left frontal	1
2. Left temporal	1
3. Right parietal	1
4. Left parietal	2
5. Mid-parietal	1
6. Occipital (unspecified)	1
7. Left occipital	3
8. Mid-occipital	1

*Miscellaneous.* It was interesting to note in 2 cases, both being eight weeks after the onset of the treatment (hair shaved over burn), that the hair had grown out from this area  $2\frac{1}{2}$  in. in one case and  $1\frac{1}{2}$  in. in the other. In one case, a young lady of twenty-four complained that since her burn her hair was becoming progressively gray (generalized, not in the area of the burn). This was a case that had had one burn, was treated immediately, remained clean and healed without scar or hair loss. The patient suffered no pain after the first day. It is the opinion of the writer that the burn did not cause the graying of the hair, which has not been observed in any of the other cases. In only one case was the burning of the hair an important factor. This was a case in which a small portion of hair was burned with only a first degree burn of the scalp.

#### TREATMENT

The treatment is very simple but like many apparently insignificant conditions the common fault is conservatism. The majority of physicians who had treated these cases, prior to their coming under the observation of the writer, made light of the burns, told the patients to apply a little oil or ointment to the scalp and evidently trusted to luck that the burns would not become infected and that they would clear up without any more radical procedure. We have seen, however, that the burns do not remain clean and that they do become infected. If we stop to consider a second degree burn of the scalp, for instance, we are dealing with a devitalized area, burned, both by heat and by the chemical solution in the waving agent (an alkali), with an area over which the superficial layer of scalp has been destroyed by blister formation, leaving an open wound, with an area covered with hair, which is anything but sterile. It is obvious then, that the susceptibility of this area to infection is extremely great. Add to this the common practice by the

beauty parlors, the patients and even by physicians, of rubbing oil or an ointment into this open wound, matting the hair down onto the wound, forming a greasy crust, under which bacteria have an ideal medium in which to carry on their work of reproduction and the destruction of tissue. This often extends deep into the layers of the scalp causing sloughing of fascia, regional adenitis, etc., with resulting scar formation and hair loss.

It is logical then that the principle on which the successful treatment of these burns depends must be the prevention of a medium for the growth of bacteria. This is best done by removing hair, dead skin, grease, dirt, crusts, sloughs, etc., from the burned area and by keeping the wound protected from contamination by a dressing which at the same time allows the penetration of air. With this principle in mind, which after all is only common-sense surgical procedure, the following technic has been used in the treatment of the 15 cases:

1. Careful examination of the entire scalp, as with thick hair, and the usual presence of oil or ointment, a burn might be easily overlooked. The burns are often multiple and scattered over all of the areas of the scalp. This examination should include careful notations as to the number, size, shape, degree, locations, presence or absence of infection, presence or absence of regional adenitis or general manifestations. These cases are liable to have a medico-legal aspect and careful, accurate note taking will save the physician embarrassing situations. (See Fig. 1.)

2. Cut the hair in the region of the burn or burns, with scissors, then shave with a sharp razor over the burn and surrounding the burn for a sufficient area to apply a dressing. This is, of course, painful but is the most important part of the treatment and rarely has to be repeated over the same burn. If this procedure is too painful, especially over a swollen infected burn, it is advisable to do it under ethyl chloride local anesthesia.

3. All foreign material such as matted hair and ointments, burned loose skin, or in infected cases, crusts, sloughs, etc. are

treat the burn caused by heat but to neutralize the alkali which has also been a factor in causing the burn. The waving

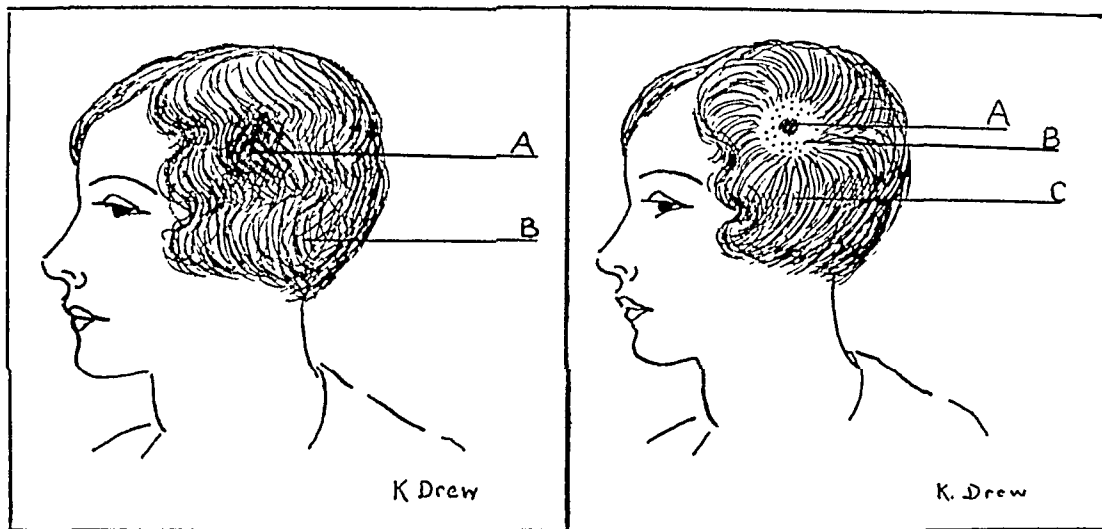


FIG. 1. A, Burned area with matted hair. B, Unburned area.

FIG. 2. A, Shaved burned area. B, Shaved area for dressing. C, Unburned area.

removed. Much of this is done with the razor during the shaving. Ethyl chloride is often employed in this procedure, where a crusted, infected area needs to be debrided.

4. The open area is now cleansed with some antiseptic solution; benzine followed by ether or just carbon tetrachloride is very good. Carbon tetrachloride or ether are especially indicated as they not only are good antiseptics but also remove the oil from the scalp, leaving a clean dry area. (See Fig. 2.)

5. This step depends on the presence or absence of infection. In a clean burn of any degree, if not more than forty-eight hours old, freshly prepared 2 per cent tannic acid is used. The patient is instructed to drop a few drops of this solution, using a medicine dropper, through the dressing onto the burn every hour that she is awake for the first forty-eight hours and then every two hours until seventy-two hours have elapsed, after which the tannic acid is discontinued. The burned area should now be well tanned. It is thereafter dressed every few days with dry sterile dressings. Tannic acid is especially indicated, not only to

agent or solution used to moisten the hair before the heat is applied in giving a permanent wave is alkaline, usually containing ammonia.

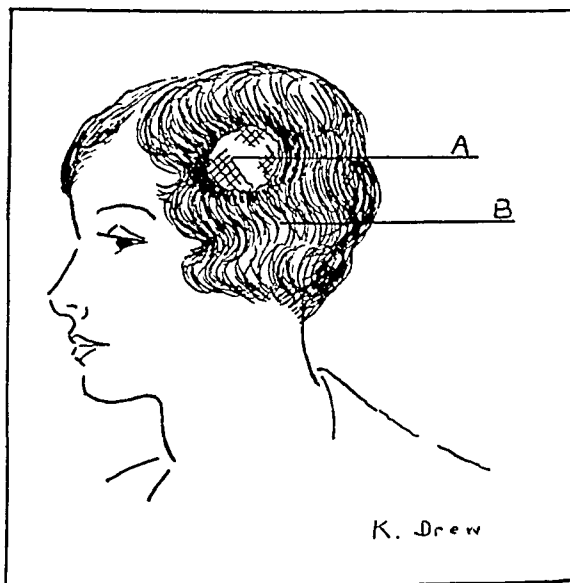


FIG. 3. A, Sterile gauze dressing over burn. B, Unburned area.

In an infected burn, ichthyol ointment may be used on the dressing followed by the application of flaxseed poultices or a hot-water bottle, to create a local hyperemia in order to localize the infection.

Tannic acid is, of course, not used on the infected burns.

6. A sterile gauze dressing is cut out to conform to the shape and size of the shaved area. The shaved area surrounding the burn is painted, by means of sterile cotton applicators, with a thin and narrow layer of liquid adhesive. A few layers of the gauze are now applied, then more liquid adhesive on the outer border of the dressing and then more gauze. This dressing is very satisfactory as it protects the burn from the hair and other contamination; it does not exclude air from the area; it allows any drainage to be absorbed by the gauze. It makes large cumbersome dressings unnecessary and the hair can be arranged to cover this dressing very readily, which, of course, is an important factor with the type of patient with which we are dealing, and lastly the liquid adhesive is better than collodion as it does not glue itself to the hair and scalp as tenaciously. (See Fig. 3.)

#### PREVENTION

Much could be said in regard to the prevention of these burns, such as proper instructions to hair dressers, prevention of the neglect in having the burns treated, etc., but that aspect is not in our province to discuss here.

#### CASE HISTORIES

It might be interesting to give the case histories of 2 rather typical cases:

CASE I. Mrs. M. F., housewife, aged forty.

*History.* While being given a permanent wave at the establishment of Mr. X by Mr. X himself, ten days previously, the patient complained of excessive heat on the scalp. The patient stated that her complaints were unheeded and that the heat was not turned off until the regular period of time had elapsed. On leaving the beauty parlor she did not realize herself, nor was she informed, that she had been burned.

On arriving home that evening Mrs. F. noticed a blister on the left side of her head to which she applied an ointment. She telephoned her family physician the following day.

He prescribed treatment by phone but did not see the patient. She continued to neglect the burn, but the pain and swelling became more severe and she noticed a lump under her jaw as well as swelling of the face and earache. She finally decided after ten days' neglect that she should put herself under medical care.

*Examination* showed an infected second degree burn of the left temporal region of the scalp  $\frac{3}{4}$  in. in diameter, surrounded by a swollen, red and tender area. Edema of the left side of the face was present as well as enlargement of the left anterior cervical lymph glands. Temperature 100°F. by mouth.

*Treatment.* The usual shaving was done, also excision of scab and central infected area under ethyl chloride local anesthesia, followed by ichthyol ointment, dressing and advice to use continuous flaxseed poultices.

*Progress.* The burn was redressed the following day and poultices continued for forty-eight hours, after which the infection had nearly subsided. She was seen a total of 7 times, the last time being fourteen days after the first visit or twenty-four days after receiving the burn.

*Result.* On the last examination there was a bald spot with hair loss  $\frac{1}{8}$  in. in diameter which was practically negligible as it was not noticeable. This is rather remarkable considering the neglect and the severity of the infection.

CASE II. Mrs. V. F., housewife, aged twenty-five.

*History.* While being given a permanent wave at the establishment of Mr. X by a student operator, a few hours previously, the patient complained of excessive heat on the top of the scalp after the heat had been applied for six minutes. The heat was removed and not reapplied. She did not realize at the time nor was she informed that the burn had occurred, but she was cautioned not to use a comb over the top of her head. This case was not neglected. Treatment was instituted on the same day that the burn was received.

*Examination* showed 3 first and second degree burns, each about  $\frac{5}{8}$  in. in diameter, distributed as follows: (1) midparietal; (2) right parietal; (3) right frontal regions. There was also slight redness and evidence of irritation on the other regions of the scalp.

*Treatment.* The usual shaving was done, removal of blebs, application of dressings and tannic acid routine instituted.

*Progress.* The patient suffered pain only on the first day. The burned areas remained clean. The patient was seen only 4 times and on the last visit, which was exactly one week after receiving the burn, the areas were healed and clean.

*Result.* The patient was discharged on the seventh day with no scar or permanent hair loss. This is, of course, an ideal case.

#### CONCLUSION

Burns of the scalp in women should be

considered as an important surgical lesion. The results of neglect, delay in treatment and inadequate (conservative) treatment are many, such as infection, resultant scars and hair loss, discomfort and disability. In contrast, dealing with cases that are not neglected, and in which the treatment is not delayed, and in which the treatment consisted of the technic already described, the results were excellent, with no infection, no scars or hair loss, and very little discomfort and disability.



## MANAGEMENT OF CONJUNCTIVITIS\*

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FULLY 25 per cent of the patients that come to an ophthalmologist in a city present some form or other of conjunctivitis and as a result, much of an ophthalmologist's time is spent with this condition. In the majority of cases, a simple inspection of the everted conjunctivae will serve to permit of a clinical diagnosis upon which treatment can be based. In a few cases, microscopic examination of the conjunctival secretion or epithelial scrapings from the conjunctival surface is required for thorough understanding of the case; but for routine office practice, such examinations are required only in the exceptional case. The majority of cases observed fall into one of the following groups:

1. Catarrhal conjunctivitis.
2. Acute or chronic follicular conjunctivitis.
3. Acute or chronic purulent conjunctivitis.
4. Subacute or chronic blepharo-conjunctivitis.
5. Secondary conjunctivitis (due to tear-sac disease, sinus infection, eserine or atropine irritation, etc.).

6. Conjunctivitis of special types as vernal, trachoma, plasmacellularis, etc.

1. *Catarrhal Conjunctivitis.* This is the most common form of conjunctivitis and manifests itself as a simple hyperemia of the tarsal conjunctiva and causes a burning or itching sensation. It is never accompanied by any purulent secretion, but there may be present a soapy foam-like-secretion which is due to the saponification of the excess secretion of the Meibomian glands. This form of inflammation may be bacterial in origin, but is more than apt to be due to some mechanical or extraneous irritation. Good results usually follow the use for several weeks of eye drops two or three times a day, composed of 2 per cent resorcin or 0.5 per cent zinc sulphate or 0.1 per cent zinc chloride in 3 per cent boric acid solution. For the past year, a 50 per cent solution of hexyl-resorcinol has been used with some satisfaction. In this type of case, which may be rather persistent, the armamentarium of the ophthalmologist must be great, for not infrequently is it necessary to vary the character of the astringent used. Among other solutoins that may be given the

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patients for home use, must be mentioned 3 per cent quinine sulphate, 1 per cent tannic acid, 0.1 per cent dilute acetic acid, and 4 per cent camphor water as an eyewash. A very satisfactory mechanical flushing solution can be prepared by the patients at home by putting into 1 quart of water, 1 teaspoonful each of ordinary table salt, baking soda, and boric acid, and adding, after solution, 1 tablespoonful of glycerine.

2. *Follicular Conjunctivitis*. By acute follicular conjunctivitis is meant that type with massive follicles that can easily be mistaken for trachoma. In this type, expression must be performed and this is best done in the hospital under general anesthesia. Subsequent to the expression, massage forms the mainstay of the treatment. For this, the conjunctivae must be anesthetized and it is preferable to use an anesthetic that does not dilate the pupil, such as 2 per cent butyn or 1 per cent holocaine or 1 per cent tutocaine. The lids are then everted and the conjunctival surfaces rubbed thoroughly with a cotton-wound applicator dipped into mineral oil. The massage is continued for several minutes until the conjunctivae are rather hyperemic. The excess of oil is then flushed off with any neutral solution. For home use, this form of conjunctivitis yields most rapidly to the use of a 1:5000 aqueous solution of oxycyanide of mercury, used in an eye-cup as an eyewash.

As a rule, the chronic follicular conjunctivitis does not need an expression; but it usually is very slow in responding to treatment. The massage with mineral oil as used in the acute form is not sufficiently stimulating and the massaging applicator should be dipped into powdered boric acid or powdered sodium salicylate. This is apt to produce a very mild bleeding from the surface of the conjunctiva, a result that is to be desired. Such treatment should not be carried out oftener than once or at the most twice a week. The same oxycyanide solution should be used at home three or four times daily.

3. *Purulent Conjunctivitis*. The common type of acute purulent conjunctivitis is usually due to a mixed infection by some forms of staphylococci, streptococci, and pneumococci. If the latter organisms predominate, the usual clinical picture presents an additional feature; namely, minute hemorrhages in the conjunctiva, involving the bulbar more than the tarsal conjunctiva. Cleanliness is necessary for rapid recovery in these cases, as well as the frequent use of a bactericidal agent. Seemingly, the most effective of the latter for home use is 1 per cent mercurochrome, used as eyedrops from two to five times a day. If the patient is careless and allows the fluid to overflow the lids, an unpleasant staining of the cheek is produced. This can be avoided by anointing the skin of the lower lid with cold cream before using the solution, removing the cream after all danger of an overflow has passed. Among other solutions that have proved effective in this condition are 4 per cent targesin, 2 per cent sophol, 10 per cent neo-silvol, and 0.5 per cent freshly prepared protargol. If there be clinical or bacteriological reason to suspect a predominance of pneumococci among the infecting organism, 1 per cent ethyl-hydro-cuprein (optochin) should be used as an adjunct. But this alone seldom eliminates the remainder of the infection. For cleansing purposes, any non-irritating solution suffices, for it is only the mechanical flushing of the conjunctival surface that is desired. Boric acid and salt solution (normal) seem to be the favorites.

In chronic purulent conjunctivitis, the treatment is much the same as in the acute forms, but is rendered less frequently. But in addition, it is usually necessary to stimulate the conjunctiva to further bacteriotropic action and for this purpose, fresh 1 per cent silver nitrate is most efficacious. The best results follow instillation without further neutralization with salt solution. It is the practice of some to paint the everted conjunctivae with silver nitrate solution and wash off

the excess of silver with normal salt solution; but this method does not allow the silver to penetrate the recesses of the transitional folds. The instillation of a drop of silver nitrate into the conjunctival sac is followed by a convulsive closure of the eyelids, which tends to spread the solution uniformly over the entire surface of the conjunctiva, including the transitional folds. Neutralization with salt solution is not necessary as the tears perform that function.

4. *Blepharo-conjunctivitis.* Subacute blepharo-conjunctivitis is seldom accompanied by ulceration of the margins of the lids, although there is a crust formation at the roots of the lashes. The conjunctivitis phase has usually preceded the blepharitis phase by a considerable period of time and as a result, there are apt to be many dead lashes visible. These may occur as:

(1) Normally situated lashes with a black root clearly visible through the surrounding tissue and with a shaft slightly darker than the normal lash shaft. When removed, the root is found to be slightly more bulbous than the normal, completely black, and much more flexible than the normal.

(2) Abnormally located new-formed lashes, much more delicate in texture than the normal. These evidently arise from a normal follicle, but emerge through a new formed channel that may lie a full millimeter nearer the conjunctival surface than the normal lash line. The roots of these lashes are also black and flexible, but are not apt to be very bulbous.

(3) Two lashes arising from one normally situated follicle. They are always of unequal size, the larger being the normal lash of that follicle and the smaller, the new-formed pathological lash with a black root. The only abnormality about the larger lash is that it is apt to be somewhat thicker and stronger than its normal fellows.

These abnormal lashes are the result of the peculiar irritation of this form of blepharo-conjunctivitis and their presence

establishes a vicious cycle. The irritation starts the abnormal lashes and the abnormal lashes, by their mere presence, continue the irritation. Consequently, they should all be removed mechanically. Electric epilation is not necessary. In addition to the epilation, the conjunctival irritation must be cared for. Violent treatment is not necessary and these respond well to the local use of 1:5000 oxycyanide of mercury two or three times daily. In addition, the edges of the lids should be well anointed each evening the last thing before retiring. For that purpose, a 1 per cent noviform ointment has given more satisfactory results than the time-honored yellow oxide of mercury ointment. The so-called Betti salve is preferred by some. The condition is not very difficult to control, but is very apt to recur unless treatment is continued for a considerable period of time after all visible manifestations of inflammation have disappeared. Continued recurrences can easily lead to the condition of chronic blepharo-conjunctivitis ulcerosa.

In chronic blepharo-conjunctivitis ulcerosa, small superficial ulcers appear at the roots of the lashes. The size and depth of the ulcers depend upon the length of time that they have existed. Accompanying them is a chronic hyperemia and thickening of the margins of the lids together with a partial or complete loss of the sharp approximating edge of the lids where the transition from the conjunctival to the skin epithelium takes place. The conjunctiva proper shows a condition of hypertrophic inflammation. Meticulous cleanliness of the lid margins is one of the essentials for recovery. The closely adherent crusts must be soaked and then wiped loose from the base of the lashes, not once but several times a day. The ulcers are thus exposed and they should be touched carefully with silver nitrate from 1 to 20 per cent strength. Care must be taken that none of the stronger silver solutions come into contact with the conjunctiva and conse-

quently the excess of silver nitrate must be neutralized completely with salt solution. This treatment should be carried out daily until the ulcerative areas have become epithelialized. For home use instillations of a bland colloidal silver solution have proved efficacious. In addition, it is well to rub into the base of the lashes an ointment containing 2 per cent resorcin and 2 per cent precipitated sulphur in a base of equal parts of lanolin and vaseline. But care must be exercised that none of this is smeared on the conjunctiva for a rather unpleasant irritation is apt to result. After the acute ulcerative condition has been relieved, it pays to modify the therapeutic measures. From here on, the use of fluorescin zinc has justified itself. This is a reddish powder formed by the combination of potassium fluorate and zinc sulphate and is soluble one part to a thousand of water. Upon solution, it reverts to its original constituents. In practical use, a small amount of the powder is rubbed gently on to the anesthetized conjunctiva where it is dissolved slowly by the tears. Thus the conjunctiva is kept bathed for several hours in a weak solution of zinc sulphate and potassium fluorate, which latter is absolutely inert.

It has been found practical to instruct patient in the use of the powder and have it applied daily at home for longer periods of time.

5. *Secondary Conjunctivitis.* But little need be said about secondary conjunctivitis beyond the fact that the diagnosis is the essential feature. There are certain peculiar stigmata to this condition that reveal it plainly to the eye of the practiced ophthalmologist. When once diagnosed, the conjunctiva clears readily following removal of the source of irritation.

6. *Special Types.* It does not lie within the scope of this general paper to discuss the treatment of the special forms of conjunctivitis gathered under this general heading. Each form in itself requires study and therapeutic artistry. Some respond to varied local treatment, others require systemic management, and many will yield only to a combination of both. The therapy of trachoma alone requires many many pages to merely scratch the surface, let alone discuss the non-surgical management of the complications. Consequently, it would seem preferable to postpone discussion of the treatment of the specialized forms of conjunctivitis for some future article.



## STENOSIS OF THE CERVIX\*

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THE intelligent treatment of any disease-process must be founded upon an understanding of the causative pathologic conditions: this is especially true in regard to those conditions (for example, stenosis of the cervix) which may be either primary, or merely secondary to some causative condition which is the essential feature of the situation. In the management of cases of stenosis of the cervix the following classification of the under-

lying pathologic processes has been found to be a reasonably satisfactory foundation upon which to build up the plan of treatment in the given case:

### I. Developmental stenosis:

1. Simple
2. Associated with:
  - a. Hypoplasia
  - b. Uterine flexion
  - c. Fusion defects

### II. Atrophic stenosis:

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1. Senile
2. After castration
- III. Traumatic stenosis:
  1. Postpartum:
    - a. Occlusive agglutination and healing together of denuded surfaces
    - b. Cicatricial contraction
  2. Postoperative:
    - a. Occlusive agglutination and healing-together of denuded surfaces or edges of flaps
    - b. Cicatricial contraction
  3. Post-radiation: cicatricial contraction and atrophy
- IV. Inflammatory stenosis (specific and non-specific infections):
  1. Endocervicitis, acute and chronic: thickening of the mucosa of the canal
  2. Occlusive agglutination and healing
  3. Cervicitis, acute and chronic:
    - a. Edema and hyperplasia of the stroma of the cervix
    - b. Contraction of inflammatory fibrous tissue
    - c. Cystic cervicitis
- V. Neoplastic stenosis:
  1. Benign:
    - a. Mucosal (fibroadenoma)
    - b. Stromal (fibromyoma, etc.)
  2. Malignant:
    - a. Cancer
    - b. Sarcoma (?)

The neoplastic group (with the exception of fibroadenoma, which rarely gives rise to obstruction of the cervical canal) are not to be considered as suitable cases for ordinary office treatment. In those cases where the stenosis is merely incidental to active or passively active inflammation (endocervicitis, edema, hyperplastic cervicitis, and cystic cervicitis) the stenosis should not be treated until after the causative condition has been relieved by appropriate treatment, because dilatation in these cases does no good and may do harm, and because the stenosis usually disappears as a symptom-producing entity upon the relief of the causative inflamma-

tory process. The treatment of these inflammatory conditions is becoming more and more an office procedure as the proper use and the effectiveness of the small electric cautery is better understood and more and more widely employed. In the presence of acute infection, dilatation is of course contraindicated.

In the developmental group (especially when associated with hypoplasia, flexion or fusion defects), in the cases of post-inflammatory and in some cases of post-operative cicatricial contraction, office treatment will frequently be found to be unsatisfactory on account of the facts that the whole length of the cervix is involved, that the tissues are very resistant to dilatation, and that dilatation of the internal os (which is absolutely essential in cases of developmental stenosis) is difficult and painful. In all of these conditions the cervix must be over-dilated to a considerable degree (40 F.) and the dilatation maintained for a time by a cervical pack (seventy-two hours) or an indwelling tube (three to six weeks, in virginal cases only) if the results of treatment are to be of any lasting duration. Only too often it will be found that a prolonged and uncomfortable series of gradual dilatations is followed by a period of relief which is much shorter than that secured by the single thorough dilatation under anesthesia. On the other hand, it is often possible to afford much relief, where symptoms begin to recur after any form of dilatation, by a single office treatment in the week preceding menstruation (or at varying intervals in menopausal cases). If the treatment room is maintained as a minor operating room, affording adequate assurance of asepsis, practically all of the cases in this group can be treated properly under local block infiltration. By using an extension sleeve (of the type employed in tonsillectomy) the needle can be inserted into the tissues about the cervix without interference with vision. About 20 c.c. of 0.5 per cent novocaine is injected in a collar completely surrounding the cervix,

the points of injection being close against the cervix and the point of the needle just beyond the vaginal wall. If the internal os is to be dilated, the needle is inserted in front of the cervix (at the positions of 10 and 2 o'clock on the clock-face), and passed up to a point just above the internal os, outside the substance of the cervix. At each of these points 10 c.c. of the anesthetic solution is injected after having made sure that the point of the needle does not lie in a blood vessel or in the peritoneal cavity. The solution diffuses pretty thoroughly into the loose parametrial tissues and into the bases of the broad ligaments, affording, usually, a very satisfactory anesthesia for any procedure which does not require much dragging-down of the uterus.

The trophic stenoses (except in hypoplasia), the cases of traumatic and inflammatory occlusion through healing-together of denuded surfaces, and some cases of minor or localized cicatricial contraction (especially post-radiation contraction) form the group in which single or repeated dilatation without anesthesia is especially successful. In using dilators of the expanding type, the screw should never be used to force the blades apart, on account of

the danger of exerting a pressure which may lacerate the cervix; the screw is, however, useful in relieving the muscles of the operator by maintaining the degree of separation of the blades secured through manual pressure. If graduated serial dilators are employed, they should be hollow, in order to avoid the piston action of the solid dilator, which may force infected material or bits of living endometrium into the tubes or into the peritoneal cavity. That this is a real danger may be shown by placing a small amount of bismuth paste in the uterine cavity prior to such dilatation and inspecting the fimbriated extremities of the tubes when the abdomen is opened. The writer has not yet reached any definite conclusion as to the effectiveness of electricity in connection with the treatment of cervical stenosis.

It is impossible to set forth any dogmatic rule in regard to the degree of dilatation and the number of treatments required, as these points must be determined through careful study of the individual case, especially in regard to the sensitiveness of the patient, the mechanical difficulties, and the degree and duration of the relief afforded.



## TONSILLECTOMY IN THE OFFICE\*

W. W. PEARSON, M.D.

DES MOINES, IOWA

WHETHER tonsillectomy should be performed in the hospital or in the office depends largely upon the office. In a one-man office, with but a single attendant, it is inadvisable. But in an office with a chief, assistants or associates who are thoroughly competent, and nurses who are properly trained for this work, it would seem that this operation can be performed as safely as it can be done in a hospital. We assume that

there is, in connection with such an office, an operating room with an equipment equal to that of any hospital operating room.

Before performing a tonsillectomy it is well to have a report from the patient's physician. Not only must one decide that there is a clear indication for the operation, but one must also be sure that the patient's physical condition warrants it. Before operation a test of the coagulability of the blood is made.

\* Submitted for publication December 18, 1929.

There is no reason why the procedure of operation in hospital and office should differ. In the case of adults, my experience justifies a local anesthetic. About half an hour before the time of operation a hypodermic of morphia is injected. There are substitutes for this but morphia acts well in the majority of cases. Everything being in readiness the nurse usually employs cocaine as local anesthetic. This is applied, on a cotton swab, about the fauces and tonsils. A clever nurse may accomplish much in the preparation of the patient, not only by allaying any disposition to nervousness, but also by training in the manner of opening the mouth, in the control of the tongue, and in proper breathing. Next the operator injects the novocaine about both tonsils. A few minutes is required for this to have the desired effect. In the case of the average patient, conversing in an ordinary manner diverts his attention and lessens his anxiety. At this stage equally skillful operators differ greatly in their ability to handle the patient. Confidence, as evidenced by experience and skill, goes far towards making the patient's position less trying. This "vocal anesthesia" is a great help.

When the first tonsil has been removed the wound should be carefully inspected and found to be in good condition before removing the second tonsil. It is well to make an application of iron or an astringent in the tonsil beds. If there is a persistent hemorrhage firm pressure is made, for a time, by means of a good sized gauze pad in a sponge holder.

As to whether the operation has been performed with the patient seated in a chair or reclining upon the operating table is a matter of choice in cases where the patient is under a local anesthetic. The operation being completed, the patient is permitted to occupy a comfortable chair or to recline on a bed. If he is on the bed it is better that he lie on his side as, in this position, the blood and saliva run easily from the mouth and clearing the throat is avoided. The longer this position is maintained the less likelihood

there is of a clot becoming dislodged and of hemorrhage resulting.

In the case of children and unusually nervous individuals a general anesthetic is used. The patient is in a reclining position on the operating table. The table should be inclined so that the head is lowered.

Too deep anesthesia is to be avoided. Aspiration should be employed. In an experience covering more than thirty years I have seen only 2 cases of lung complications and both of these were early in my practice.

Following operation, under general anesthesia, application other than pressure at the bed of the tonsils, to control hemorrhage, is not employed.

At this point we have arrived at the debatable ground as to the respective merits of hospital or office operation. All things being equal I prefer the office operation. The average case, after office operation, rests in the office for two or three hours. At the end of this time the patient returns to his home, to the hotel if accompanied by relative or friend, or to the hospital if there is any reason for so doing, such as a tendency to bleed, excessive nervousness, being alone in the city, etc. In any event he is supplied with telephone numbers of the force so that, in case anything untoward develops, he may call for and receive assistance within a very short time.

In my experience it has been found necessary to use a ligature only a very few times. No patient of mine has been lost from hemorrhage following tonsillectomy.

The patient, being in an operating room, at the office, next door to several surgeons, is assured of better care and more prompt attention than would be the case were he in a hospital in charge of interns with less experience. Should the necessity arise, any one of the doctors in the office could step in and care for him much more quickly and conveniently than could be done were he in a hospital.

There can be no hard and fast rule as

to whether tonsillectomy should be performed at the hospital or at the office. This operation should not be undertaken lightly. There should be well-defined indications for it. The result of the examination by an internist should be had, especially in questionable cases. Even when the surgeon prefers the office operation he must be guided by the condition and wishes

of each individual patient. A careful study of the patient, a thorough knowledge of the location under consideration as to anomalies, an accurate operation, the comfort and safety of the patient; all these should be the controlling factors in deciding which is the more suitable place for performing tonsillectomy, the hospital or the office.



## URETHRAL CARUNCLE\*

PAUL A. FERRIER, M.D.

PASADENA, CALIF.

**U**RETHRAL caruncle is a distressing neoplasm common in women. While patients may have suffered for years, they are often unable or unwilling to have hospital treatment. An effective office treatment is very desirable.

The cause of caruncle is not known. It occurs at any age, but is most common in mid-life. It may be of any size, from that of a pinhead to that of a raspberry. It may be sessile or pedunculated, but it is practically always located on the posterior rim of the female urethral meatus. At times it is excruciatingly painful. Skene said; "In these extremely painful neoplasms some patients give evidence of constant pain, distress and anxiety; they are pale, emaciated, low-spirited, and wish for death." Some caruncles are not sensitive.

### PATHOLOGY

Virchow describes the growth as a vascular polyp. Histologically it is composed of tufts of capillaries in a fibrous and muscular stroma, more or less infiltrated with round cells, according to its degree of inflammation. No nerve endings are found except in the covering epithelium. Cancer has been frequently known to arise on a caruncle.

### DIAGNOSIS

It must be differentiated from:

1. Prolapsed urethral mucosa. This, however, will be seen to pout completely around the meatus.
2. Varicosities. These subside when the patient is in the Trendelenburg position.
3. Condylomata. They are generally associated with similar growths on other parts of the vulva.
4. Cysts of Skene's gland.
5. Solid tumors of the urethra. They are rare, and are seldom limited to the area of the posterior rim and are more solid.

### TREATMENT

The conditions to be met are:

1. Complete eradication.
2. Restoration to normal of the urethra, particularly avoiding stricture or tractions on the bladder neck.
3. Obtaining a specimen for histological study to rule out malignancy.
4. Minimizing the inconvenience to the patient.

Many methods have been used, but the essential of all is the complete removal of that part of the basement membrane bearing the tumor. Anything less than complete removal is sure to be followed by recurrence. Lawson Tait mentioned a case in which a tumor had been removed every five years for forty years. In some such cases the scarring is more damaging than the original caruncle. Stricture is

\* Submitted for publication December 18, 1929.

frequently caused by fulguration or deep cautery.

When a growth is sessile, resection as

its base as recommended by Crenshaw with a slightly curved hemostat, which has been ground flat resembling a miniature

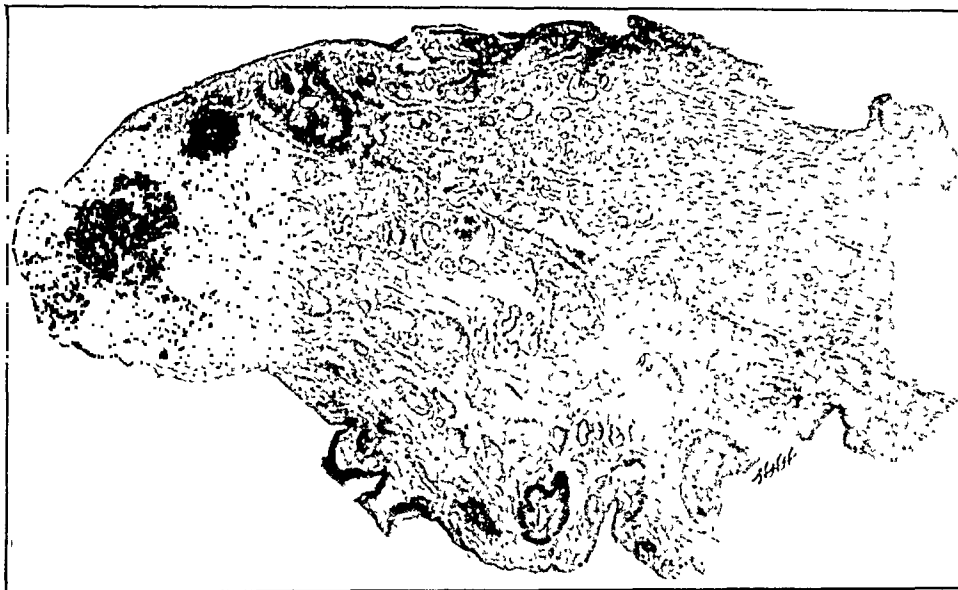


FIG. 1. Urethral caruncle. Centrally, many of the vessels are in loose fibrous stroma; surface is covered by layer of partly squamous and partly transitional epithelium at margin. (From Kelly and Burnam's Diseases of the Kidneys, Ureters and Bladder, D. Appleton & Co.)

practiced by Kelly is necessary, but this is a hospital procedure.

Fulguration is widely used, but it almost always burns too deeply, leaving a heavy scar. The convalescence is unnecessarily long and painful, and stricture often follows. Hot iron and chemical cautery are even more objectionable.

The following method is very satisfactory for all but the broadly sessile type. It is an office procedure, and is a modification of a method suggested by Crenshaw.

#### OFFICE TREATMENT OF CARUNCLE

The patient is placed in the lithotomy position, and given a thorough soap and water cleansing. Local anesthesia is obtained by a tablet of  $2\frac{1}{4}$  grains of cocaine in just sufficient water and lubricating jelly to saturate a cotton applicator, which is inserted into the external urinary meatus. In about five minutes an assistant separates the labia. The urethra is dilated and the margins of the growth defined. The caruncle is then drawn up with a fine Allis forceps and clamped beyond

hemorrhoid clamp. The protruding caruncle is cut off and preserved for section, while the cut edge is carefully cauterized with a very fine electric cautery, such as is used in the nose.

If the procedure is properly carried out only one fine line of cautery is present, which heals rapidly without pain. No postoperative treatment is necessary. After healing is complete one urethral dilation should be done. If the caruncle is so broad that it cannot be included in such a clamp the method is not applicable. In my experience it has been useful for half the cases.

The advantages of this method are:

1. It is an office procedure.
2. It is painless with local anesthesia.
3. There is no bleeding.
4. Immediate relief is obtained.
5. A specimen is available for microscopic diagnosis.
6. On account of the narrow linear scar a minimum of epithelization is necessary, and stricture does not follow.
7. Recurrences are few.

# DEPARTMENT OF RADIOLOGY

JAMES T. CASE, M.D., F.A.C.S., EDITOR

## INTRAVENOUS UROGRAPHY BY MEANS OF UROSELECTAN\*

M. SWICK, M.D.

NEW YORK

THIS work was begun with Selectan Neutral,<sup>1</sup> synthesized by Professor Binz and Doctor R  th and utilized against coccus infections on the Medical Service of Professor Lichtwitz at the St  dtisches Krankenhaus, Hamburg-Altona.<sup>2</sup> The study of its excretion<sup>3</sup> and its iodine content (54 per cent) led to the thought that it might be applicable for roentgenologic purposes. Experiments on rabbits demonstrated the fact that the kidney parenchyma and urinary bladder could be visualized after the intravenous administration of the drug; the pelvis and ureter, on the other hand, were poorly seen. Ligation of the latter did, however, bring the upper tract well into view. Simultaneous studies of its excretion, limited to quantitative determinations of the iodine component, revealed 75 to 80 per cent of the injected iodine in the urine. Save for traces of the latter element in the bile, its pres-

ence in the tissues and feces could never be detected.

Concerning toxicity and tolerance, it was found that 0.2 grams per kilogram of weight could be intravenously administered to the rabbit without any demonstrable ill effects; 0.33 grams per kilogram, however, produced transient generalized disturbances. On the basis of these calculations, one could theoretically give to a sixty kilogram individual eighteen grams of the substance as a maximal dose. Because of marked individual differences in man, the quantity administered was far below the above calculated one. Headache, nausea, vomiting and, in two cases, transient diplopia were disturbing factors. However, there never occurred a reaction severe enough to distract one from pursuing the studies. The oral and rectal administration of Selectan Neutral yielded similar roentgenologic results and toxic manifestations. In all cases the urinary bladder was seen. The kidney parenchyma appeared to stand out more in relief; in two cases of contracted kidneys the reduction in size could be noted. Only on producing a temporary artificial obstruction in the ureter by means of a bougie at the time of maximum excretion was the upper genito-urinary tract outlined, though not very prominently. In other words, the attained results, though not sufficiently good for practical purposes, pointed to the possibilities of further development. The problem then resolved itself into a modification of the substance so as to accomplish the following:

<sup>1</sup> In 1923 Osborne, Sutherland, Scholl and Rowntree were the first to attempt the visualization of the urinary tract by means of intravenous injection of a 10 % solution of sodium iodide. In 1924 Rosenstein and von Lichtenberg repeated the work with iodide in conjunction with the perirenal pneumo-radiographic method of Rosenstein. Volkmann, in 1924, Lenarduzzi and Pecco in 1927, have also given an account of their findings. Hryntschak, at a congress in 1928 and in the *Zeitschrift f  r Urologie*, 1929, reported his work. Finally, Reseno by means of the intravenous use of a substance containing sodium iodide bound to urea was the first to achieve practical results but apparently associated with some reactions.

<sup>2</sup> Swick, M. *Klinische Wochenschrift* 1929, 8, 2087. von Lichtenberg and Swick, M. *Klinische Wochenschrift*, 1929, 8, 2089.

<sup>3</sup> Some studies of the excretion into the bile or urine had been done, though not reported, by Erbach in Prof. Lichtwitz's Clinic.

\* Presented by invitation before the Section of Genito-Urinary Surgery, N. Y. Academy of Medicine, Jan. 15, 1930. Work done under a grant from The Emanuel Libman Fellowship Fund.

(1) To diminish the toxicity through the substitution of the methyl group in order to permit the administration of a



FIG. 1. Female, 37 years old Left renal and right ureteral calculi. Both kidneys, pelvis, ureters and bladder visualized, Dilatation of left pelvis and ureter. X-ray taken 15 minutes after injection.

larger dose and thus attain a higher concentration of the excreted iodine component, a determining factor for roentgenologic success. (The observation in two cases of double vision led to the suspicion, at least empirically, that the methyl radical of the Selectan Neutral might be responsible for the toxic manifestations.)

(2) To increase its solubility.

(3) To increase the iodine content of the molecule.

(4) To possibly increase the affinity for the kidney.

Thereafter the work was continued on the urological service of Professor von Lichtenberg at the St. Hedwig Kranken-

haus in Berlin. To eight cases 7.5 grams of the original substance, Selectan Neutral, were administered by mouth with the already described toxic reactions. The bladder was seen in all cases. Only in one case, that of a stone obstruction of the ureter, about one inch below the uretero-pelvic junction, was a useful x-ray film obtained. The further studies, as already pointed out, occupied themselves with the seeking and application of other substances of similar nature with, however, the substitution of the methyl radical.

With the above prerequisites in view; Professor Binz and Doctor R  th of the Landwirtschaftliche Hochschule in Berlin (Chemical Institute) prepared modifications of the original substance. The first because of their higher iodine content, were very poorly soluble in water and unsuitable for intravenous application. Oral administration was likewise inadequate because of their poor absorption by the gastro-intestinal tract. With the reduction of the iodine content and the substitution of the methyl radical, the clinically applicable and successful substance, Uroselectan, was finally obtained.

Uroselectan is non-toxic, very soluble in water, neutral in its reaction, and under normal conditions excreted as such through the genito-urinary tract within eight hours practically to the extent of 90 to 100 per cent, suggesting the likelihood that no chemical reaction takes place in the body. Examination of the blood for the presence of the iodine component fails to reveal it at different intervals five minutes to three hours after the injection. Studies upon the tissues for the distribution of Uroselectan are still in progress. The iodine in the molecule exists in a very stable organically bound state. Neither in solution nor in its excreted form is the iodine present in an inorganic, ionized state. This fact together with the relatively large quantity of the calculated iodine element of Uroselectan that can with impunity be administered would lead one to reason, at least empirically,



FIG. 2.

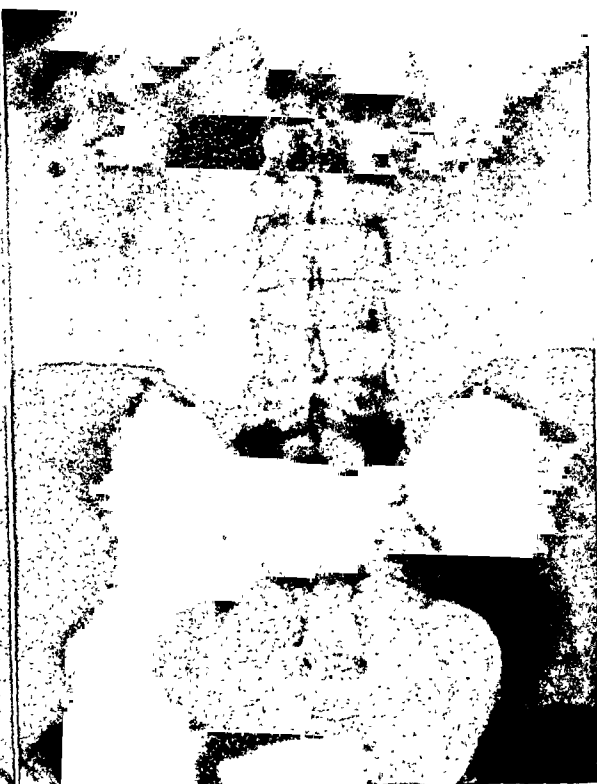


FIG. 3.

FIGS. 2 and 3. Male, 54 years old. Left renal calculi in pelvis and lower calyx. Right urinary tract normal. Fig. 4 shows almost complete emptying on the right side and points of constriction at the calyceal necks as well as stones in pelvis and calyx.



FIG. 4. Male, 37 years old. Left ureteral calculus. Dilatation of left ureter and pelvis. Right kidney and pelvis appear to be rotated on themselves. X-ray taken 30 minutes after injection.



FIG. 5. Female, 40 years old. Left solitary kidney. Entire urinary system visualized.



why iodism has never been observed. Apparently one can speak of the toxic and therapeutic effects of an iodide when

characterized as the normal "thrust-excretion," present during the first two hours. To illustrate, about three-fifths of

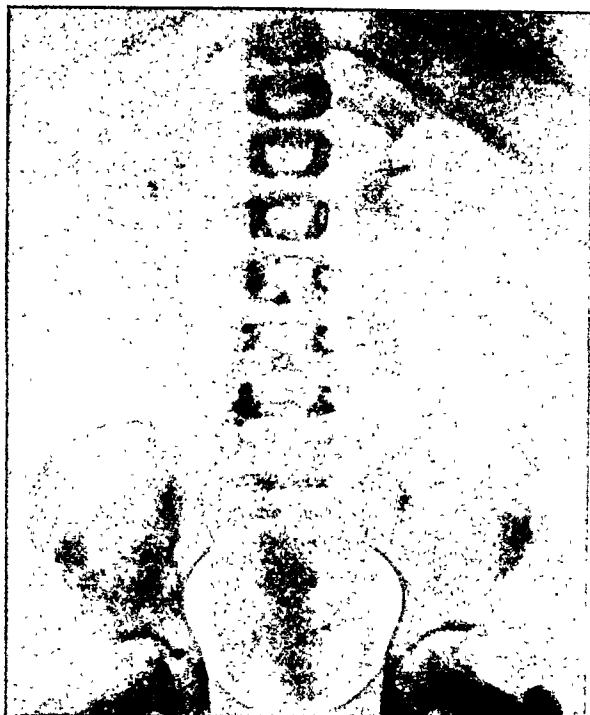


FIG. 6. Female,  $5\frac{1}{2}$  years old "Pyelitis." Dilatation of right ureter and pelvis. Twist of right ureter just below uretero-pelvic junction. X-ray taken 45 minutes after injection.

the iodine exists in an inorganic ionized form.

Its tolerance is exceedingly great. To a mouse, seven grams per kilogram of body weight can be intravenously administered without ill effects. As a test dose the same rabbit repeatedly received intravenously three grams per kilogram of body weight. Utilizing the latter dose as a basis for calculation, it follows that 180 grams of the substance, in terms of iodine, 75.6 grams, can be theoretically administered to a sixty kilogram individual.

Quantitative determinations of the excreted substance can form the basis for a functional test. Studies in this direction are still being continued. From the results already obtained, it appears that a normally functioning kidney possesses the ability to excrete this substance with a thrust, that is, a relatively large quantity within a given short period. This can be

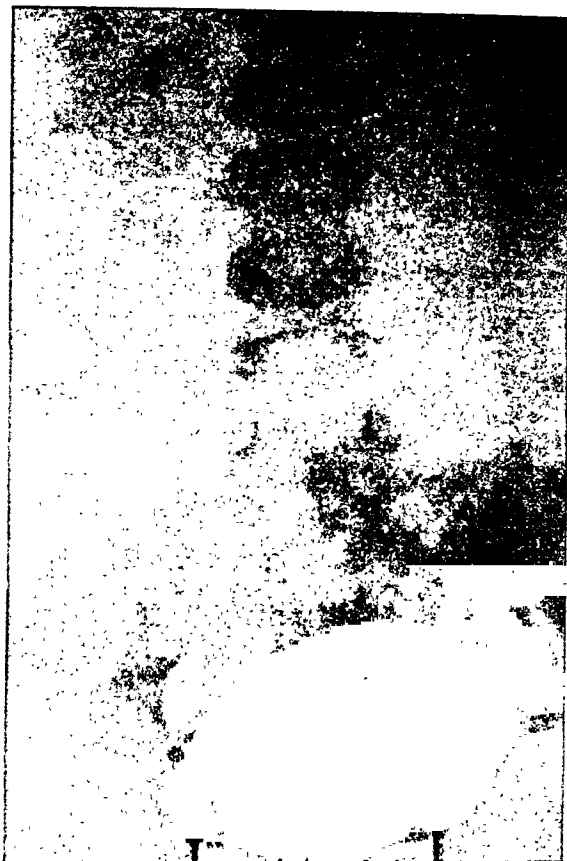


FIG. 7. Female, 2 years old. Tumor occupying right half of abdomen. Normal left urinary tract and bladder visualized. Questionable shadow running transversely on right side from crest of ilium to sacro-iliac synchondrosis—renal pelvis. X-ray taken 50 minutes after injection.

the substance is excreted during the first two hours, about one-quarter during the next, and the remainder during the subsequent four hours. Aside from the dose administered and the extrarenal factors influencing renal secretion, the "thrust-excretion" ability of the normally functioning kidney plays a vital role in determining good roentgenologic visualization. In spite of the fact that substance is excreted during the subsequent periods, poor or no visualization is obtained. Good visualization is dependent upon a definite concentration of the shadow-giving element, determined by the factors enumerated. When the additional pathological

factor of obstruction is present, the otherwise normal height of excretion, provided that excretion takes place, is not so essential. Accordingly, visualization or poor visualization or non-visualization of the genito-urinary tract is dependent upon the functional activity. In other words, the concentrating ability of the kidney tissue, irrespective of whether that functional activity be temporarily or permanently conditioned. Therefore, to evaluate the intravenous method of pyelography and to correctly interpret the results therefrom, it is of paramount importance to consider this method an excretory one and to constantly bear in mind the processes occurring in the renal and extrarenal systems, factors determining renal function. The mere non-visualization does not necessarily signify permanent renal functional inhibition, for the secretory activities of a kidney can be temporarily hindered. In addition to anatomical data derived by this physiological route, another vitally important function of the urinary tract that can be studied without the introduction of artificial means is the functional-dynamic activity of the pelvis, ureter and bladder.

**Method of administration:** For an adult from thirty-three to forty grams are dissolved in doubly distilled water to a volume of one-hundred cubic centimeters. The solution is filtered twice through ordinary filter paper and sterilized in a water bath or autoclave at fifteen pounds of pressure for one-half hour. A child of seven years receives half and a child of two years one-quarter of the dose administered to an adult. The syringe method in preference to that of the gravity is chosen in order to avoid any possibility of foreign-body reaction from tubing. Five to six syringes plus needles are sterilized in distilled water. The injection is done in two stages at intervals of three to five minutes. The first x-ray examination, under usual conditions, is usually made about fifteen minutes after the last injection, the second about twenty to thirty minutes after the first x-ray plate and the third a corre-

sponding period after the second. The number of subsequent plates and the time at which they are taken depend upon the



FIG. 8. Female, 10 years old. "Pyelitis." Both sides visualized, slight dilatation and atony present. X-ray taken 35 minutes after injection.

functional activity and derangement of the kidney. Where the function is poor, it is wise to take subsequent plates roughly at two to four hour intervals and to gage one's course according to the density of the shadow present. Experience alone can guide one.

**Reactions:** During the injection the patients experience transient thirst and generalized warmth, particularly involving the face and bladder region. Only twice was nausea transiently present. Shivering and vomiting of very short duration occurred in a case of nephrosis (case of Professor von Lichtenberg). To a child of ten (Professor von Lichtenberg's clinic), a case of bilateral insufficiency of the

ureteral orifices with well advanced bilateral pyelonephritic contracted kidneys, about nineteen grams of substance were

lost. In none were there any alarming symptoms or signs observed. It seems that Uroselectan for purposes of intravenous



FIG. 9. Male, 43 years old. Adenocarcinoma of upper pole of left kidney. Left kidney appears to be enlarged. Left upper calyx not well visualized. Right side normal. X-ray taken 15 minutes after injection.

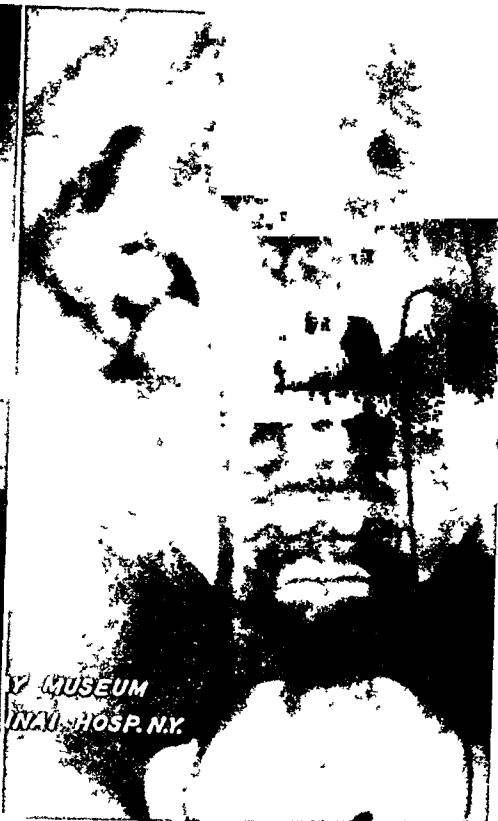


FIG. 10. Pyelogram from below, of the same patient, led to the suspicion of a polycystic kidney.

administered. The child was uremic for a long time previous to the injection (RN 92 per cent). She had had attacks of amaurosis and somnolence. During the latter days there were vomiting and sleepiness. For eight hours after the injection, no reaction set in, subsequently, however, increased drowsiness and gradual cardiac failure were followed by death. Autopsy revealed a marked degree of cardiac hypertrophy, exceedingly severely infected contracted kidneys with double megalo-ureters. There were no macroscopic evidences of drug intoxication. Among the cases examined up to the present, there were children, old people, patients with bilateral kidney disease, patients with prostatic hypertrophy and cardiac disease, and those with active and inactive tubercu-

pyelography is well tolerated and yields practical results.

Its field of application becomes evident whenever ureteral catheterization is dangerous or mechanically impossible; where mechanical or infectious factors of the lower genito-urinary tract prohibit instrumental interference. In the presence of bleeding, and in cases of implanted ureters; in children, and in individuals in whom instrumentation is taxing or harmful, the clinical value of the intravenous method becomes obvious. Its application for pyeloscopic purposes will only be feasible where the density of the excreted substance is sufficient. In other words, its pyeloscopic usage will not be applicable for all cases. Where the function is poor, pyeloscopic results will be correspondingly deficient. In reading the results, one will have to con-

sider the physiological-pathological as well as the anatomical factors. Experience and adaptation will aid in the interpretation

cordially thank Dr. Swick for this really great contribution, and to congratulate him on finally solving this problem that during recent years



FIG. 11. Male, 30 years old. Hydronephrosis with findings suggestive of changes at the middle and lower calyces. Absence of visualization on the right side. X-ray taken 4 hours after injection.

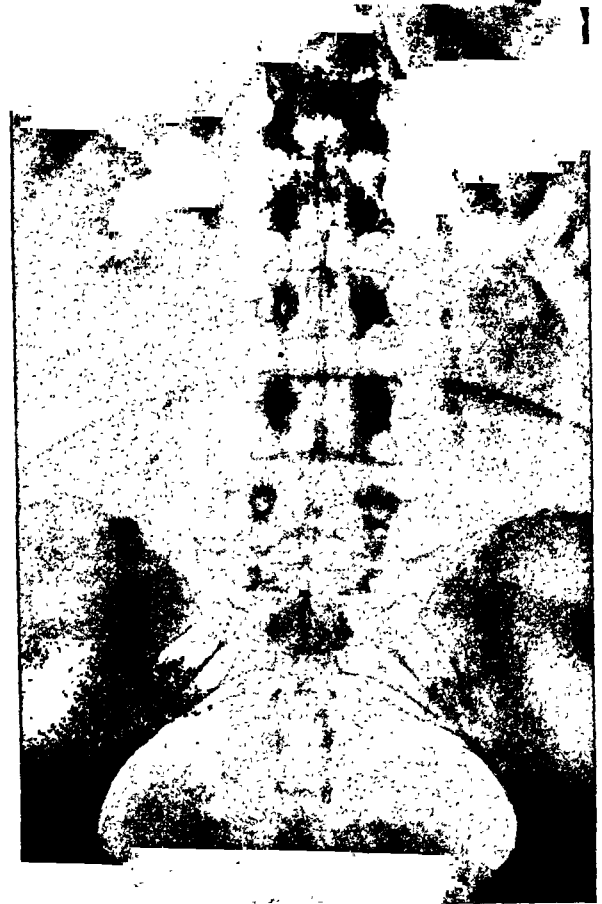


FIG. 12. Female, 23 years old. Post-operative intravenous pyelogram one year after implantation of the left ureter into the bladder for a vesico-ureteral fistula. Function and anatomical relations normal. X-ray taken 15 minutes after injection.

and evaluation of the roentgenologic findings attained by this method.

In closing, I want to thank Doctor Stevens and the Genito-Urinary Section for the privilege extended me this evening. In addition, I wish to express my gratitude to Professors Binz, Lichtwitz, and von Lichtenberg for their help and cooperation, and to Doctors Beer and Jaches.

#### DISCUSSION

DR. BEER: Dr. Swick has just presented one of the most important contributions to general medicine and to urological and general surgery to which I have ever had the pleasure of listening. The great value of this new medium is difficult to evaluate completely at this moment, but without indulging in any ecstatic prognostications as to the wide field of usefulness of uroselectan,<sup>1</sup> I wish to take this opportunity to

<sup>1</sup> The manufacturers of uroselectan, have as yet been unable to distribute more than samples in the U. S. A.

has been attacked by a number of excellent workers.

My remarks I have placed on paper, both for the sake of clarity and brevity. We have just seen a series of clear pictures of the whole urinary tract made by this new method, pictures of such clarity as to be of great diagnostic value. In some of the cases, skilled cystoscopists regularly failed to obtain pictures by the usual cystoscopic methods and therefore definite diagnoses could not be established. In other cases no injections into the ureters could be made as they were implanted in the intestines. These cases show a startling conquest and clear demonstration of the value of this new method.

To one who has had many years of experience

in this line of work, the possibilities of uroselectan are enormous.

Both Swick and v. Lichtenberg vouch for its non-toxicity and its rapid disappearance from the blood. They find it intensifies the kidney shadows, appears in the urine early and in sufficient concentration to produce excellent shadows under the x-ray, both in the pelvis and ureter, as well as in the bladder. Moreover, depending on the renal function, the rapidity and the duration of the excretion of the iodide varies as both Swick and v. Lichtenberg have reported, and as we have seen in the films just presented tonight. An estimate of the iodide output both quantitatively and chronologically may supplement the radiographic functional test.

In view of these facts it must be evident that with uroselectan in the future the general practitioner will, with the aid of the radiologist be able to make periodic health controls of his patients, which will be accurate without relying on time honored and unsatisfactory urine analyses and palpation. In this way, lesions of a surgical character in kidneys, ureters and bladders will be spotted at a much earlier period than at present, when many patients and physicians still dread cystoscopic pyelography.

Another method of studying the motor function of the urinary tract is presented to us perhaps infinitely better than the pyeloscopy practiced at the Necker Hospital, where catheters in the urinary passages may produce all sorts of inhibitory or stimulating effects. Pyeloscopy and ureteroscopy with uroselectan may give us many interesting and valuable new viewpoints, both concerning healthy and diseased urinary tracts.

In a study of 84 cases, v. Lichtenberg states that 61, or 75 per cent gave satisfactory diagnostic data. In 22, cystoscopy with retrograde pyelography was necessary. From his study of the uroselectan, controlled by the usual cystoscopic methods he believes he may conclude:

A. Absence of kidney shadow means (1) no kidney (agenesis), or (2) almost functionless kidneys.

B. Absence may also be evident in extensive tumors, pyonephroses and badly infected obstructed kidneys.

C. Also in bad heart disease with insufficiency.

D. Also in peripheral obstruction with infec-

tion (occasionally bilateral absence of shadow). *On the other hand excellent shadows are obtained in hydronephroses, in ureter stones, kidney stones and other mildly obstructed conditions with fair or good renal function.*

Before closing these appreciative remarks, let me mention some further possibilities of this method, some of which have been touched on by Dr. Swick, and others hinted at by myself.

It is generally believed that if during a resection of the bladder for carcinoma one must sacrifice a ureter, that it does not avail anything to re-implant such a ureter in a new place in the reconstructed bladder. In view of this, many surgeons recommend ligating and dropping the tied ureter. My own experience does not bear out this viewpoint as I have seen such a kidney six years after neostomy with excellent preservation of parenchyma. One such case Dr. Swick has just shown and the study of a series of similar cases and the result of this research will be of great value, as cystoscopic control with catheterization of the re-implanted ureter is usually almost impossible.

Furthermore, there are a fair number of cases where ureters have been cut during operation and have been subsequently re-implanted, the duration of life of such kidneys and their functional activity can probably be studied by the uroselectan method much better than by cystoscopy. We have a series of such cases for Dr. Swick to work on. In addition, cases with ureters implanted in the intestine, such as have been shown tonight, can only be studied and controlled properly by some such method as Dr. Swick has described. Patients who have had pyeloplastic procedures and ureter implantations into the pelvis will also lend themselves nicely to this method. Above all, patients that are not fit for cystoscopy, or who object to the usual repeated retrograde pyelographic methods will benefit by this great improvement.

In closing I must admit that I have been thoroughly stirred by Dr. Swick's excellent work, and congratulate him again, and all of us and our future patients in that he has found the path to successful intravenous pyelography.

DR. ABRAHAM HYMAN: We at Mount Sinai Hospital who have been fortunate enough to follow Dr. Swick's work are just beginning to realize the value of his method of pyelography. It not only opens up new vistas, but will undoubtedly place urological diagnosis on an even more accurate basis than it is at present.

Dr. Beer has already called attention to its possibilities in the field of general medicine and surgery. It appeals to one from many points of view. In the first place, it is an entirely physiological procedure outlining both kidneys, the ureters and bladder from above, and does away with artefacts caused by retrograde pyelography. It also settles once and for all the question of simultaneous bilateral pyelography, a matter which has given rise to considerable adverse criticism during the past few years.

Intravenous pyelography offers an excellent method of studying dynamic conditions within the pelvis and ureter, and from what we have observed so far also gives us a radiographic functional test. To interpret radiograms taken in this way we must, however, change our concepts to some extent. The kidney shadow itself shows up more intensely than in the ordinary pyelogram, although in general the pelvis and ureter are not as distinctly outlined as they are with retrograde pyelography. In the presence of obstruction in the ureter or pelvis the intravenous pyelogram is more intense than in non-obstructive conditions. Its success depends, of course, upon the functional activity of the kidney, a non-functioning organ not being visualized. While this usually denotes anatomical destruction of a kidney, in one case of calculous pyonephrosis the opposite apparently healthy organ failed to visualize and thus brought up the question of the proper interpretation of the absence of a shadow should a kidney be reflexly inhibited. This patient died from uremia following a suprapubic cystotomy for stone performed under local anesthesia. The blood chemistry just before death was considerably elevated although it had been normal prior to operation. Undoubtedly the failure to visualize the kidney was due to a non-functionating organ, and not to a reflex inhibition.

We have had the opportunity of studying by this method a number of selected cases which presented unusual difficulties in diagnosis, and have found it of great value. In several instances the ureters could not be catheterized and the data obtained by intravenous pyelography was of considerable aid in determining operative indications. In a case of ureterocele which had been fulgurated previously a number of attempts to introduce a ureter catheter had failed. No indigo carmine was observed coming from the region of the ureter orifice. The ques-

tion arose as to whether this was a functioning kidney, and intravenous pyelography distinctly showed a moderately hydronephrotic kidney with a ureter outlined all the way down to the bladder. As a result, it was decided to attempt a plastic operation on the lower end of the ureter, which proved successful.

To what extent this method will supplant retrograde pyelography cannot be determined at present but, briefly, it should prove of considerable value in such instances as the following:

The many cases which cannot be cystoscoped or in which the ureters cannot be catheterized for one reason or another.

It will probably bring to light many unsuspected anomalies of the urinary tract.

In urological conditions in children, where it will be especially valuable.

In elucidating many problems which we have hitherto been unable to clarify, notably the dynamics and function of the kidney and ureter after implantation into either the bowel or the bladder.

It will probably supplant retrograde pyelography in tuberculosis of the urinary tract, as in these cases there has always been the danger of unpleasant reactions.

It may help to clarify the situation considerably as far as ureteral strictures are concerned.

In prostatic cases it will undoubtedly assist in demonstrating the condition of the upper urinary tract without resorting to ureteral catheterization.

In closing, let me extend my heartiest congratulations to Dr. Swick for this most valuable contribution to urology.

DR. SWICK, closing: Experience up to the present has not been sufficiently large to permit drawing any conclusions concerning the visualization of uric acid stones by means of this method. Further study is necessary. Compression from without by means of a rubber bag for about 5 minutes prior to the x-ray and then its removal when using the x-ray seems to yield denser pictures.

My experience concerning the restriction of fluid has not been very great, but it seems that it is wiser to permit relatively large quantities of fluid the day previous to the injection. These are points in which we are interested and continuing further studies.

It is important in evaluating and interpreting the results from the standpoint of function, to bear in mind that the functional activity of a

kidney can be temporarily or permanently inhibited and the mere non-visualization at a particular examination does not necessarily mean a permanently damaged kidney. I am referring particularly to a case of two-day

anuria, during which time an intravenous injection yielded negative results. Two weeks later, however, when the function from both sides was normal, a repeated intravenous pyelographic test yielded positive results.



## ROENTGEN STUDY OF APICAL CHEST TUMORS\*

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CERTAIN types of tumors located within the chest are sufficiently numerous to deserve a more careful study than has usually been accorded them. The metastatic malignancy involving the pulmonary fields, with its balls of cotton fluff, and the massive or infiltrative carcinoma from some remote primary focus, involving the parenchyma in a widespread involvement, as well as the primary malignancy within the chest, are matters of frequent occurrence in any busy hospital department. The primary carcinoma of the lung originating at the hilum and spreading fanwise in its invasion of the pulmonary fields presents a picture which offers little or no diagnostic difficulty and early becomes familiar to the students of roentgenology. The type of tumor, however, which we wish to present cannot be demonstrated as having origin in the mediastinal structures or the region of the hilum, apparently originating in the apex quite independently of these structures. Pancoast<sup>1</sup> has called attention to several of these neoplasms, and recorded a very excellent review of the clinical, radiologic and pathologic aspects of the subject. It is his opinion that the majority of these have fallen under the classification of primary endothelioma of the pleura, although, as he states specifically, certain of these tumors, lacking necropsy reports with microscopic findings, can only be

so classed in view of their distinct similarity to others which have been fully proved. In our own cases also it is unfortunate that necropsy findings cannot be furnished upon all cases and, along with Pancoast, we again only assume that the similarity of the clinical manifestations, negative physical findings and uniform roentgen-ray observations, which form the basis of the opinion, render these tumors most probably members of the same group in which necropsy has proved the correctness of the opinion.

Roentgenologically, the major facts connected with these tumors seem to be their uniform location in the apex of the chest where they are completely isolated from the hilum, and, since they are not of mediastinal origin, have no tendency to displace the trachea, as is so commonly seen in other types of tumors. Characterized by a lower border which is very sharp and usually almost perfectly straight, there seems to be little or no tendency to invade the subjacent lung tissue, while the tumor as a whole presents a uniform density, quite unlike the mottling or ramifications of the lesions of tuberculosis.

Beyond the lesion in the apex, the chest usually presents no shadows of interest, thus causing the large fan-shaped tumor to stand out all the more distinctly by contrast, while the infrequency of metastasis to more distant locations, and the absence of the habit of forming fluid (characteristics so common in other chest tumors) serve still further to set these

<sup>1</sup> PANCOAST, H. K. Importance of careful roentgen-ray investigations of apical chest tumors. *J. A. M. A.*, 83: 1407-1411, 1924.

\* Submitted for publication December 18, 1929.

apart in a separate group of their own. Neither in Pancoast's series nor in my own was fluid observed in any case.

can easily pardon the look of incredulity on the face of a clinician and understand his hesitancy in accepting the findings



FIG. 1. Tumor in right apex. Left base injected with lipiodol.



FIG. 2. Same case as Figure 1. Both bases injected with lipiodol. Secretion from bronchiectasis filling bronchi on right. Tumor in right apex. One month after Figure 1.

A diffuse thickening of the pleura from a previous inflammatory process may possibly serve to confuse, but since this is almost certain to exhibit a reflection off the chest wall at some point near its margin, the differentiation should not be difficult. It may be safely assumed that a tumor which conforms to the dicta just set forth will in all likelihood fall into the classification of pleural endotheliomas.

To this may be added the two outstanding clinical observations: viz., increasingly severe pain in the shoulder, radiating down the arm; and the suprising disproportion between the magnitude of the roentgen findings and the physical signs which can be elicited. In fact, one of the most astonishing aspects of the whole business is the paucity of physical findings during the course of an examination. It has been our experience that under the most careful and skillful physical examination by undoubted leaders of the profession, the ordinary changes of dullness and alteration in breath sounds almost uniformly have been absent, so that one

when the roentgenogram of such a condition is exhibited for his inspection. It seems almost incredible that these tumors should escape detection by ordinary methods of examination, especially when their magnificent sweep is exhibited upon the roentgenogram.

That not all tumors of the apex fall into this classification is of course obvious; we have no intention of contending upon this point. That tumors arising from the mediastinum and extending toward the apex are not characterized by the dicta which we have set forth is frequently illustrated. Reference to Figures 9 and 10 in a suspected case of pleural endothelioma, shows very clearly that this does not have the uniform density, the straight lower margin and the other characteristics which have been described as peculiar to the condition under discussion.

An observation about which no very strong feeling is had regarding its value as a prognostic sign has occurred with



sufficient frequency to justify its discussion. Shortly before death, from three to four weeks, these tumors have exhibited a

In his monumental work on "Neoplastic Diseases" Ewing describes these tumors as "originating in the form of multiple

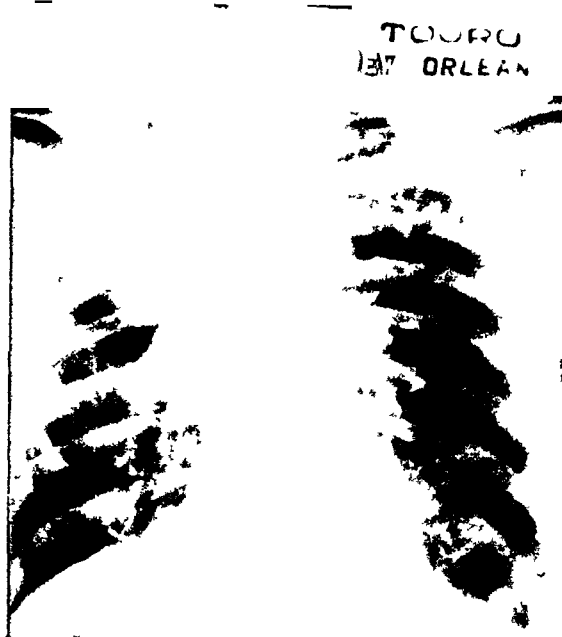


FIG. 3. Same case as Figures 1 and 2. Sixty days later. Note breaking through of lower margin of tumor. Death shortly after.



FIG. 4. Case III. Elevation of diaphragm on left side. Tumor in left apex. Clinical symptoms, pain in left arm.

tendency to break through the lower margin and to dip down into the structures immediately beneath. In three instances occurring in this series, this has taken place without any demonstrable metastasis to other neighboring or distant organs. That such metastases have occurred, however, cannot be controverted; and, in the light of our deficient autopsy findings, we cannot feel too strongly upon this point, contenting ourselves only with the view that no demonstrable lesions were visible at any point in the osseous system or lungs and that no enlargement of the abdominal viscera could be had. It is likewise true that no symptoms causing suspicion of metastasis to the brain appeared in any of our cases before death. That metastatic invasions do occur in this type of lesion, however, is borne out in Case III. In the absence of invasion the absorption of toxic products must undoubtedly be the occasion of death, since the patients in the terminal stages present a profound anemia and cachexia.

nodules or flat elevations, widely distributed over either the parietal or visceral pleura, or perhaps both. These nodules or plaques fuse to form a dense firm mass which covers and compresses the lung. A serofibrinous or bloody exudate accompanies the growth, which gathers in small cysts or larger collections." This fluid does not become free in the chest, however.

Histologically the structure is rather uniformly that of alveolar and tubular endothelioma. The cells are of moderate size, of polyhedral or flat form, with hyperchromatic, vesicular nuclei and faint nucleoli. They lie in small alveoli or long single or multiple rows between cellular or hyaline connective tissue to which they are usually intimately adherent.

The question as to whether these tumors show a tendency to metastasis has had a large number of proponents on each side. That one case in my own series unquestionably extended to the cervical glands is in accord with Ewing's expressed view, wherein he states: "It

is possible that two groups of serous endotheliomas should be recognized, one invasive, with metastases, and derived

he applied for relief. The blood pressure was noted as 124/80. The heart was declared to offer no clinical evidence of disease. Over the



FIG. 5. Large tumor, right apex. Previous films show no connection with hilum. Death from endothelioma of pleura.



FIG. 6. Large tumor right apex, previously shown to spring from apex, without hilar connection.

from the endothelium of lymph spaces, and another, superficial, nodular or papillary, and originating from the lining cells." "All agree," says Ewing, "that the process begins over a wide area."

The following case reports may be considered as typical for the entire series:

CASE 1. Mr. A. F. A., aged fifty-nine, was seen through the courtesy of Dr. W. P. Bradburn, March 11, 1926. He had for some years at varying periods suffered from a cough somewhat intractable, more commonly observed in the morning than in the evening, and productive of a very thick, tenacious sputum. He has since childhood noted occasional attacks of semiconsciousness, with rigidity of many muscles in his body. The remainder of the history is without particular interest, other than that the productive cough has been characterized by numerous physicians as bronchiectasis. At the time of the examination, the patient states that for the preceding six months there had been a pain, increasing in severity, in the right shoulder, above the right clavicle and down the arm. This had increased in intensity and it was for this condition that

base of the right lung a few râles could be heard: the breathing was cavernous in type, so that the diagnosis of bronchiectasis, which had stood for some time, was concurred in by Dr. Bradburn. Upon more careful questioning, a history of intermittent hoarseness, the duration of which coincided with the pain, was brought out and the further confidence that upon the morning of application for treatment, a small amount of blood was expectorated. At this time, the patient was referred for otolaryngologic examination, which proved to be productive of no great information, the upper respiratory tract being approximately normal. The roentgenographic examination disclosed a large fan-shaped shadow, apparently that of a tumor, occupying the upper right lung, extending from the apex down to a level slightly below the clavicle. The uniformity of its density, the straight lower margin, and the fact that this could not be demonstrated as arising from the mediastinum, brought forth the expression of an opinion that this was in all likelihood a primary endothelioma of the pleura. (Fig. 1.) A bronchoscopic examination by Dr. Lynch demonstrated a fairly large quantity of mucus coming from the bronchus of the middle and lower lobe, but apparently

none from the upper lobe. The instillation of lipiodol into the lower lobe elicited the shadows produced in Fig. 2, in which the lipiodol is

chest. The pain began to be noticeable in August 1925, occurring at intervals and was associated with some muscular twitching at



FIG. 7. Case 11. Moderately early recognition of tumor in right apex. Not connected with hilum.



FIG. 8. Typical appearance of apical tumor in moderately early stage. Tumor in left apex.

observed to come to rest in the larger bronchi, apparently being arrested upon the level of a fluid occupying these bronchi so that the bronchioles and alveoli are not filled with this substance at any time. Upon the left side no such bronchial filling has occurred, thus allowing the lipiodol to find its way into the bronchioles and alveoli.

Repeated x-ray examination demonstrated no particular changes in the tumor until October 29, 1926, at which time, as observed in Figure 3, a breaking-down of the lower margin and an invasion of the lung tissue at a lower level is seen to have occurred. At this time the pain had greatly increased, particularly down the arm, and a division of the posterior roots was contemplated for relief of pain. Aphonia by this time had become a very definite and distressing symptom. This patient, however, came to his end before a surgical procedure could be undertaken. At no time during the course of the observation was it possible to demonstrate ocular changes.

**CASE 11.** Mr. R. M., aged thirty-eight, was seen through the courtesy of Dr. I. I. Lemann. The patient presented himself on January 19, 1926, complaining of pain in the

the time of the pain. For the past 2 or 3 months, the pain had been very constant and increasing in intensity. Aspirin at the beginning proved beneficial in 5 grain doses but at the present time 30 grains proved necessary even for moderate comfort. The pain had remained confined to the right chest and down the right arm, the principal point of the pain being above the 4th rib. Prior to coming under our observation, both fluoroscopic and film examinations had produced the report of: "increased density in the right apex, uniform in type without mottling, associated with enlarged peribronchial glands on the right, with a normal heart and aorta. The probability of tuberculosis seems evident."

The general appearance upon presentation to us was of a fairly well nourished, rather sallow anemic individual, 5 feet  $5\frac{1}{2}$  inches in height, weight 119 $\frac{3}{4}$  lb.: the heart rate was 80 and upon percussion exhibited normal size and outline. The abdomen was without interest. The pupils were equal, regular and symmetrical, reacting to light and accommodation. The knee jerks were lively and there was noted at this time a marked clubbing of the fingers. The pulmonary examination disclosed an occasional sonorous râle heard upon the right side over

the major portion of the upper half of the lung, and extending out to the axilla. No crepitant or subcrepitant râles could be

mid-way between the arm pit and elbow;" while a further note dated March 11 states that "the pain is still increasing." Morphine

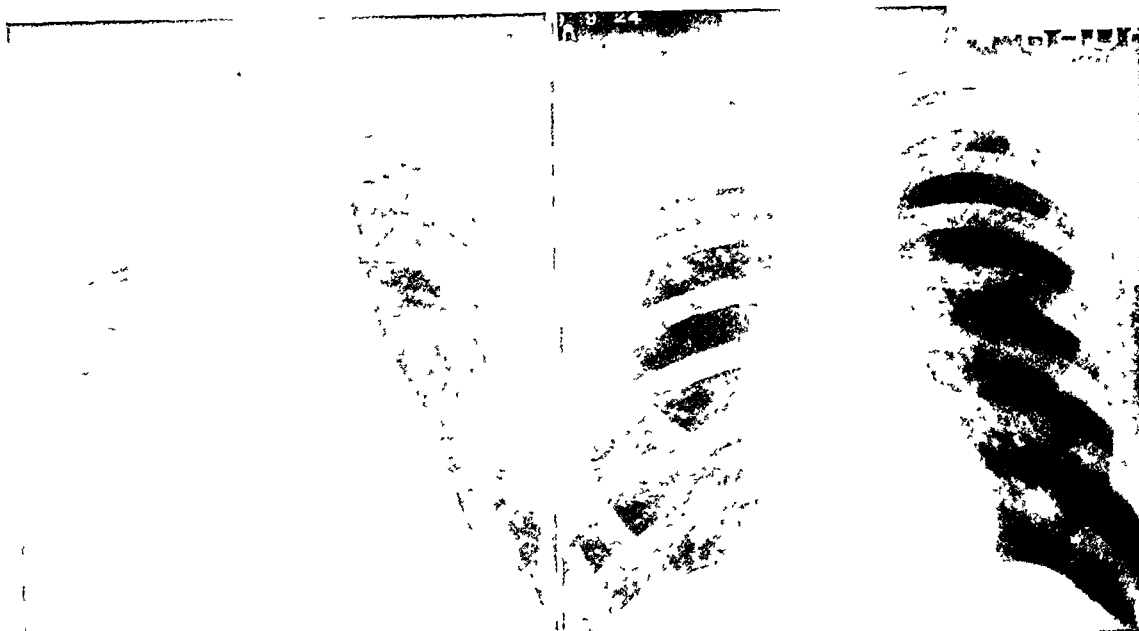


FIG. 9. Tumor of apex suggestive of endothelioma of pleura, except for connection with hilum and fluid formation in right base. See Figure 10.

FIG. 10. Earlier film of same case as Figure 9. Tumor springing from right hilum.

elicited; there was a minor amount of dullness over the right lung in the supraclavicular spaces as low as the 2nd rib anterior and posteriorly as low as the 5th dorsal spine. Over this area there was likewise a suggestion of bronchial breathing.

The patient passed through my hands on January 19, 1926, at which time there was observed a large shadow occupying the entire apex, uniformly dense and somewhat triangular in shape. The lower margin was quite sharp and regular. The homogeneity of the shadow together with its size, position and lack of involvement of either the contiguous or opposite lung tissue was considered to be very suggestive of neoplasm rather than tuberculosis. Further study upon February 18, 1926 failed to disclose any evidence of osseous erosion either in the spine or ribs, nor could evidence of change over the previous roentgenogram be observed. Passing from under our observation, we have a note of March 5, 1926 in which the patient states that "the pain seems to have increased both in intensity and in area. It goes over the chest, down the right arm almost to the elbow, being most intense in the chest just above and to the left of the right nipple, in the armpit and a point

was shortly resorted to pending the division of the posterior roots for relief of pain, but on approximately the 1st of May the picture was terminated by death, the death certificate bearing the notation "carcinoma of the lung."

CASE III. Mr. A. N. M., aged thirty-five, a telegraph operator by occupation, presented himself upon January 14, 1926, complaining of pain in the left shoulder and down the left arm. Approximately four months previous to admission, his attention was called to a stinging, burning pain extending from the shoulder down the arm to reach its point of greatest intensity at the left elbow. Since then this had proceeded down the dorsum of the forearm to the ring and little fingers, and there has been a sense of weakness in the left hand. There now appeared to be a small mass not at all sensitive and considered to be enlarged lymph nodes on the left side of the neck. There was no pain in the neck at any time but there had been a gradually increasing hoarseness for which the patient could not account. The appetite was unusually good and there had been no loss of weight. Aside from the usual diseases of childhood, the previous history was without interest except for an attack of right-sided pneumonia in 1910 which was

uncomplicated. The examination of the nose and throat were without interest, and particular attention is called to the fact that no eye symptoms could be observed. The abdomen was likewise without interest, as was the heart; the examination of the lungs was stated to disclose no evidence of pathology upon either side, and to demonstrate normal breath sounds; that the diaphragms expanded in normal manner; and that, with the exception of a few muscial râles in the left chest, heard intermittently, there was nothing in the chest to attract attention. The pain in the shoulder and down the arm was considered probably dependent upon cervical ribs, examination for which he was referred to me on January 15, 1926. Figure 4 illustrates the condition found at this time. It is scarcely probable that the elevation of the left diaphragm could account for the discomfort down the arm, this being much more probably accounted for by a shadow of uniform density and with straight lower margins without infiltration of the adjacent structures, which is seen to occupy the upper portion of the left lung. A section removed from the tumor in the neck (lymph nodes) brought from the Department of Pathology the diagnosis of neoplasm of the endothelial type, secondary to a primary focus. Further observation was precluded following the patient's leaving the hospital but a subsequent note states that the patient succumbed, the death certificate giving as a primary cause of death, new growth of the left lung.

Contrary to the findings of Pancoast we have observed little or no ocular symptoms, and likewise, contrary to his findings, our cases have been almost uniformly attended with hoarseness, advanced in certain cases to the degree of aphonia. The observation of erosion of the ribs and vertebrae on the affected side

in his cases which presented ocular symptoms would seem to offer the explanation, since the muscle of Mueller, which is the accessory elevator of the lid, receives its major nerve supply through the sympathetic system, this no doubt being involved in the process when extension has become sufficient to produce an actual destruction of osseous tissue. The absence of ptosis of the lid in my own series is therefore compatible with the fact that we were unable to observe erosions of the contiguous bones at any time.

This series to date comprises a total of 8 cases, of which 7 occurred in adults. The ages in the adults lay between the extremes of eighteen and fifty-nine. A single case occurred in a child of two and one-half years which conformed so closely to the changes in the recognized cases that there should have been little doubt as to the true nature of the tumor. This unfortunately escaped detection until the necropsy brought to light the exact pathology. Had I at the time been aware of Hibler's case described by Ewing, occurring in a child of five years, such chagrin might possibly have been avoided. With the exception of the very youthful patient, the series is represented entirely in the male sex who have come from separate sections of the state, and of widely varying occupations. Necropsy reports upon 4 of the 8 cases presented give the cause of death as primary endothelioma involving the pleura. Unfortunately, the remainder of these cases originated in neighboring towns, with death occurring at home, so that no necropsy findings are available for inclusion in this report.



# PRACTICAL CONCLUSIONS AS TO THE NATURE AND BEHAVIOR OF GRENZ RAYS (BUCKY)\*

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## GENERAL CONSIDERATION

WHETHER the introduction of the "grenz ray" into practice constitutes a marked advance depends upon whether the tolerance of the skin for these rays is judged greater than its tolerance for the roentgen ray. Since the comparison greatly favors the grenz ray, its excellence in skin therapy, taking similar results for granted, points in two directions. The first leads to a field already conceded to the roentgen ray, although its tilling was not always as fruitful as could be wished since the narrow margin of skin tolerance tied the therapist's hands. It is precisely in this that the grenz ray impressed me at once as significant, for it was possible to expose diseased skin to the alterative effect of the grenz rays for as long as was required to relieve the skin of its perverted form of reaction.

The other direction leads to new territory. The means for administering greater amounts of radiation at a single exposure, and, if necessary, for a long time, opens up a field of work the results of which may be predicated by the possibilities. My reflections relate preeminently to pigmentary nevus, vascular nevus, cavernous angioma and lupus vulgaris. This possibility of employment for the grenz rays is based upon a quality of radiation which excludes injury. According to our experience a tension of 9 kv. max. is recommended. Exceptionally, and only in special cases, as simple sycosis, skin cancer or epithelioma, and in general irradiation, as recommended by Bucky, we use 11 kv. max.

We determine dosage by means of Kuestner's dosimeter in terms of R units, the dosages varying from 70 to 11,000 R. The tube-skin distance is 2 to 70 mm.

The size of the field irradiated varies directly with the distance and has a diameter of from 20 to 70 mm. with our technic. Results as well as prevention of unfavorable effects depend on exact control and continuous corrective regulation of the entire apparatus. The grenz-ray therapist, like others, must master the technic and physics of this method, and must not be careless because the danger is less.

From the onset the importance of exact dosage was obvious to us. For this reason we designedly worked out the precise physical fundamentals from the beginning. Dr. Kirsch, an assistant in my clinic, and Dr. Gfroer, a physicist, developed in the physical laboratory of my clinic a system of measuring, which has met all requirements. Bucky's approval, when visiting our clinic, was of great satisfaction to us. The essence of the method is the determination that each apparatus actually presents the kilovoltage at the tube which is claimed by the manufacturer. These conditions must be controlled continuously. Kirsch tests this out with a large Hartman and Braun kilovoltmeter in connection with a large hot cathode valve tube. But individual tubes may vary considerably in their ray intensity in spite of equal tension (construction of tube and thickness of Lindemann window). Therefore the output of the tube must be determined exactly. The best way is to check and control the energy in R units by means of an ionometer. We use Kuestner's device for this purpose.

*General therapy*, as practiced by Bucky, has great and, in my opinion, growing value, just as has local treatment. No doubt, a profound effect is exerted on the entire organism, the vegetative system and duct-

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less glands, alone and in combination. In the course of general radiation, following Bucky's directions, *general* and *local* reactions arise, the former indicated by exhaustion, weariness, loss of appetite; the latter, cutaneous, through increase of the pathologic condition. As secondary effects we often observed regulation of formerly somewhat irregular menses, stimulation of the flow, a general increase of vitality of the individual, indicating a profound constitutional effect. When talking of by-effects we use this expression in regard to the skin disease which gave the indication for grenz-ray therapy, and do not consider these effects of secondary therapeutic importance.

A striking example of this sort was the case of a seven-year-old child, backward mentally and physically, dull, listless, undernourished, depressed, a poor eater. In his early infancy a skin affection began as multiple keratoderma of the palms, soles, genital region, perineum, and about the mouth. He was bald, even without lanugo. His spinal fluid and Wassermann test were negative, and the sella turcica normal. During the first series of general applications, local and constitutional reactions took place, but improvement of the general and skin conditions occurred soon after. Eight weeks later a second series followed. The local and general condition improved steadily. The boy began to eat well, became animated and cheerful. There are now hardly any pathological changes left in the skin, which never had been treated locally. The hair appeared and steadily increased.

Another case was not so favorable. The condition was similar, but more severe. The child was twelve years old when treatment was begun. The third series of irradiation brought about no improvement except in a vague general sense, greater ability to concentrate and pay attention. A previous rectal incontinence was controlled.

A case of extensive spontaneous gangrene of the skin is worth mentioning. Generalized irradiation had the effect of

controlling outbreaks save for a few slight ones. The treatment is not yet completed. This patient is referred to, not as an example of a cure, but for the purpose of indicating the usefulness as to the discovery of new indications for its use. Another observation was made after intensive local irradiation in a twenty-year-old girl with severe and extensive eczema dating from childhood, not of the constitutional leptosomous type described by me, often seen in eczema, but of the athletic pycnotic sort. She was adipose; she took no further reductive diet since it had been ineffectual before grenz ray treatment. Gradually her weight dropped and stayed normal after local treatment on large fields with a tension of 9 kv. max. This must have been caused by the effect of the grenz rays on her ductless glands. The explanation might be the peculiar result of the decomposition analysis of the endocrine organs according to Abderhalden by means of the interferometric method after Loewe-Hirsch. Before the treatment the thyroid secretion is largely decomposed, but, if after irradiation the weight becomes normal, no decomposition is present.

No undesired reactions were ever observed by us with 9 kv. max. and an intensity up to 11,000 R.

In another interesting and important instance in which a pigmentary nevus had been treated with 11,000 R, ulceration took place. It differed from a roentgen ulcer by being practically painless and superficial, and because it healed completely and rapidly. At times itching, slight erythema followed by brownish to dark brown hyperkeratotic scaling, or exudative erythema occur. Such reactions may arise within from a few days to five weeks after exposure.

As to repeating treatments, I favor interruptions of one week after 230 R, two weeks after 460 R, and three to four weeks when the dosage has been greater. I never resume treatment before the reaction has disappeared.

## SPECIAL INDICATIONS IN SKIN DISEASES

*Eczema* (subacute, inflammatory): 110 to 220 R.

*Eczema* (chronic): 460 R.

*Pruritus with lichenification* (Vidal): 460 R.

*Psoriasis*: 230 to 460 R.

Chronic, keratotic, thickened lesions: 920 R at times with heat (sensibilisation).

Scalp: 460 to 690 R every fortnight.

*Lichen planus*: Like psoriasis.

*Dermatitis* (active): 460 R.

*Rosacea with acne*: 230 or 460 or 690 R.

When there is a great deal of acne formation I use filtered x-rays, or grenz-rays, 11 KV tension, and about 4000 R. Recently I add, at Bucky's suggestion, general irradiation, if local does not suffice. Its influences on the flushes is excellent. General treatment is indicated. With such a procedure sometimes the reaction after local treatment fails to appear. Diet and medical treatment (aconite, sulphur) of the flushes are necessary besides.

*Acne varioliformis*: 460 R, diet; Alpine lamp in the intervals.

*Perniones*: 920 R.

*Scleroderma* and the sclerodermatous form of idiopathic atrophy: 1380 R.

*Keloids*, spontaneous and cicatricial: 2300 to 4600 R, at times with heat.

*Lupus vulgaris*: Simple form, 4600 R with heat or 11,000 R with intervals from two to four weeks according to reaction.

*Ulcerating form*, 4600 R fortnightly.

*In scar tissue*, 4600 R with heat.

*Verrucous form, necrogenic verruca, tuberculosis verrucosa* as ordinary form, 4600 R with heat or 11,000 R.

*Erythema Induratum*: Darier's sarcoid, lupoid Roeckl: 4300 R with heat.

*Lupus erythematosus*: Experiences with this therapeutically difficult and incalculable dermatosis are the same as with other methods: both unsatisfactory and excellent results. Reaction cannot be foreseen and even exacerbations might follow. I begin with a low dose: 110 R, at two to three week intervals. If necessary and possible I go up to 460 R at intervals of two to six to twelve weeks. Reactions must always be allowed to subside. Therapeutic effect often slow; therefore, patience is necessary.

*Verruca vulgaris*: 4900 R with heat.

*Juvenile warts*: 460 R. If necessary 690 to 920 R.

*Nevus pigmentosus*: 4600 R. Repeat till results are satisfactory.

*Nevus pigmentosus fibromatosus*: 4600 R with heat.

*Nevus vasculosus* (flat): 820 R with intervals of four to five weeks. Improvement often is delayed.

*Tumor vasculosus*: 1380 R.

*Alopecia prematura*: 460 R at intervals of four weeks.

*Sluggish ulcers* (irrespective of cause): 4600 R at intervals of two weeks.

*Sycosis simplex*: Success in my experience, as in Bucky's, depends upon whether the areas have been previously treated with the roentgen rays or not. If they have been, the outlook is poorer. 11 kv. max., 1425 R (Bucky).

*Skin cancer, Epithelioma*: 9 kv. max. do not suffice; 11 kv. max., 4000 R (Bucky), much better.





# ENDOTHELIOMYELOMA OF THE PUBIS WITH GENERALIZED METASTASES

## CASE REPORT\*

CHARLES MURRAY GRATZ, M.D.

NEW YORK

THE patient, J. H., a girl, seven years of age, was perfectly well until June 23, 1928, when she slipped and fell in the bathtub, resulting in an injury to the region of the symphysis pubis. The trauma was so slight that it attracted little attention until July 10, when her parents first noticed that she walked with a slight limp, favoring the left leg. From July 13, she complained of definite pain when moving the left hip though the distress was somewhat relieved by rest.

At the request of Dr. Irving Okin of Passaic, New Jersey, I saw the case in consultation on July 15. Physical examination at that time showed slight atrophy of the upper third of the left thigh and very slight limitation of motion of the left hip with slight pain in the extremes of motion, particularly abduction and hyperextension. Pressure over the symphysis pubis elicited no pain. There was, however, a definite enlargement of the left inguinal lymph glands. The patient had been running a slight fever of about 1°F., and had a slightly positive von Pirquet reaction. The urine at that time was positive for Bence-Jones protein. The rest of the examination, carefully checked, was negative.

Dr. Okin ordered an x-ray examination on July 13 which showed a destructive process starting just to the left of the symphysis pubis and also extending downward on the ischium; the lesion was further complicated by the pathological fracture.

Provisional diagnosis of primary bone tumor with pathological fracture was made at the time of consultation. Other possibilities considered in making a differential diagnosis were:

1. Osteomyelitis.
2. Tuberculosis.
3. Secondary bone tumor.

Further x-ray films of the lungs were requested, to be followed by x-ray therapy. The patient was placed in a spica and kept in bed in the interval.

It is of interest to note that the films of the lungs taken at this time were regarded as negative by myself and several other doctors, but when compared with films taken October 22, it is possible that metastases noted on the later films may have been present even then.

Further x-ray studies were made on July 30, (Fig. 1) which were reported by Dr. R. Herendeen as follows:

The entire left pubis is the seat of a destructive process and is irregular in outline, lacking normal density. There are no localized areas of destruction or reaction and no sequestra are seen. The changes usually noted in osteomyelitis are not seen. The medullary portion of bone seems slightly widened, but the most significant finding is the diffuse infiltration which gives to the films the features frequently noted in endotheliomyeloma or Ewing's tumor. The acetabulum is clean-cut in outline, as is also the head of the femur. The epiphyseal lines in this region show no changes. In this respect, the condition does not follow the usual methods of involvement in tuberculosis. Roentgen diagnosis: Endotheliomyeloma.

Clinically and radiologically, we felt justified in making a final diagnosis of endotheliomyeloma with pathological fracture, and x-ray therapy, as first suggested at the time of consultation, was carried out by Dr. R. Herendeen. The details of this treatment follows:

Treatment 1, July 30, 1928.

Area, left groin anterior.

Spark Gap: 10 in.

Filter: 4 mm. Al.

Distance: 12 in.

Ma: 4

Time: 7 min.

Treatment 2, August 2, 1928.

Area, left groin anterior.

Spark Gap: 10 in.

Filter: 4 mm. Al.

Distance: 12 in.

Ma: 4

Time: 8 min.

\* Submitted for publication December 18, 1929.

Treatment 3, August 16, 1928.

Area, left hip, a.p.

Spark Gap: 10 in.

Filter: 4 mm. Al.

Distance: 12 in.

Ma: 4

Time: 10 min.

Treatment 4, September 6, 1928.

Area, left pelvis anterior.

Spark Gap: 10 in.

Filter: 4 mm. Al.

Distance: 12 in.

Ma: 4

Time: 10 min.

Treatment 5, November 18, 1928.

Area, left pelvis anteroposterior.

Spark Gap: 10 in.

Filter: 4 mm. Al.

Distance: 12 in.

Ma: 4

Time: 10 min.

Record of radiation to the lungs, after pulmonary involvement was found, was as follows:

Treatment 1, November 9, 1928.

Area, left chest anterior.

Size of area, 4 × 4.

Spark Gap: 175 k.v.

Filter: 0.5 mm. Cu.

Distance: 30 cm.

Ma: 30.

Time: 5 min.

Treatment 2, November 21, 1928.

Area, right chest lower posterior.

Size of area, 6 × 6.

Spark Gap: 175 k.v.

Filter: 0.5 mm. Cu.

Distance: 30 cm.

Ma: 30

Time: 3 min.

Treatment 3, November 26, 1928.

Area, left chest anterior oblique.

Spark Gap: 175 k.v.

Filter: 0.5 mm. Cu.

Distance: 30 cm.

Ma: 30.

Time: 3 min.

Treatment 4, November 29, 1928.

Area, right chest posterior oblique.

Size of area, 6 × 8.

Spark Gap: 175 k.v.

Filter: 0.5 mm. Cu.

Distance: 30 cm.

Ma: 30.

Time: 3 min.

Treatment 5, December 1, 1928.

Area, left chest posterior oblique.

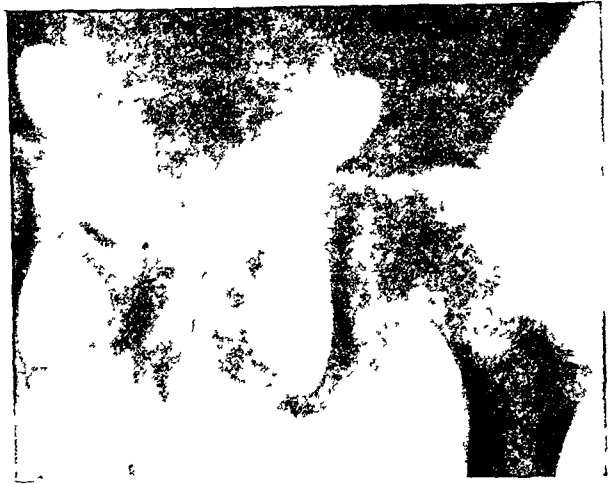


FIG. 1. X-ray film of July 30 showing extent of involvement at this time.

Size of area, 6 × 6.

Spark Gap: 175 k.v.

Filter: 0.5 mm. Cu.

Distance: 50 cm.

Ma: 30.

Time: 6 min.

Treatment 6, December 4, 1928.

Area, right chest anterior oblique.

Size of area, 4 × 6.

Spark Gap: 175 k.v.

Filter: 0.5 mm. Cu.

Distance: 30 cm.

Ma: 30.

Time: 3½ min.

In addition to above, radium pack was used to the left pubis by Dr. William B. Coley on December 15, 1928, as noted later.

It is interesting to note that during the first part of this treatment, there was a definite improvement in the child's condition. The cast was kept in place to prevent any possibility of further fracture, and in the latter part of August 1928, the films were shown to Dr. William B. Coley and our diagnosis was confirmed by him. Further x-ray studies were made on October 18, 1928 which showed a definite increase in severity of the destructive process. Accordingly, renewed examination of the lungs was made and we found that these films (Fig. 2) showed a definite pulmonary involvement. Further consultation with Dr. James Ewing as well as Dr. Herendeen confirmed the original diagnosis of endothelio-

myeloma, and Dr. Ewing advised continuing x-ray therapy to include the lungs, and further suggested that Coley's toxins might be of

made as comfortable as possible. There was gradually increasing emaciation and the patient died on May 5, 1929.



FIG. 2. X-ray film of October 22 showing definite pulmonary metastasis.

value in conjunction with x-ray therapy. The latter was carried out at the Hospital for the Ruptured and Crippled beginning October 23, 1928, after the case had been seen in consultation with Dr. Coley and under his immediate direction. Dr. Coley's report was as follows:

The toxins were started on October 23, 1928, beginning with  $\frac{1}{4}$  min. gradually increasing until 3 min. were given on November 4, resulting in a reaction up to  $104^{\circ}$ .

Further roentgenograms showed no increase in the size of the tumor, but a small round metastasis appearing.

From November 9 to December 1, toxins were omitted as she was receiving x-ray therapy. They were again started on December 3 and continued on the 7th, 9th, 11th and 13th the last on the 18th of December, when the dosage of 7 min. was given. Radium pack was applied on December 15.

For the first two weeks, the x-ray studies showed some increase in both the pelvic tumor and the metastases. Films taken December 5, showed no increase in the tumors of the lungs over the ones taken November 17 (Fig. 3). On December 22, x-ray showed a very definite increase in the pelvic tumor, which cannot only be shown by x-ray but was definitely palpable. There was also an increase in size of the tumors of the lungs.

The patient lost weight steadily. General condition became decidedly worse. It was felt that nothing could be gained by further treatment of toxins and radiation. The patient was advised to be taken home and



FIG. 3. X-ray film of November showing marked increase in size of tumor.

#### AUTOPSY REPORT

*Anatomical Diagnosis.* 1. Endotheliomyeloma of pubis.

2. Metastases to lungs, pleurae, liver and diaphragm. Implants on bladder and peritoneum.

3. Purulent cystitis.

4. Ascending renal infection; pyelonephritis.

*General.* Body of an emaciated female child. Abdomen markedly distended. There was marked edema of left leg and marked emaciation of right leg. On opening the body, 1 liter of straw-colored fluid escaped from abdomen.

*Bladder.* Distended, contained about 500 c.c. of slightly cloudy urine.

*Lungs.* Studded with opaque tumor nodules varying in size from 0.5 to 4 cm. Both lungs adherent to parietal pleura, which in turn was studded with tumor tissue. The tumors were firm, opaque without necrosis, and some projected from the pleural surface in polypoid form.

*Heart.* Normal in size. Right ventricle slightly thickened. Valves normal.

*Stomach.* Negative.

*Intestines.* Markedly inflated with gas. Two minute skin metastases appeared over the inguinal region.

*Kidneys.* Pelvis dilated. Turbid, purulent urine.

*Spleen.* Slight postmortem decomposition. No metastases.

*Liver.* Much enlarged, extended completely across mid-abdomen. Two-thirds of organ replaced by tumor tissue. Gall bladder distended with fluid bile.

*Gross Description of Tumor.* The tumor arose in the left pubic bone, involved this bone, the ischium, nearly the whole of the ilium, the acetabulum and neck of femur; all of which were encased in the mass of tumor tissue and largely destroyed thereby. Tumor also involved the wall of the bladder, entire mass measuring  $20 \times 18 \times 15$  cm. On section it had a peculiar lobulated arrangement and the texture was of a fine, spongy character

with very little necrosis. There was a pathological fracture near the head of femur.

*Microscopic.* *Endotheliomyeloma.* The tumor tissue was composed by medium-sized polyhyal and rounded cells with large vesicular nuclei which were very hyperchromatic and made up most of the cell. These cells were arranged in columns or rosettes, or they grew diffusely. The rosettes represented imperfectly formed capillary blood vessels. There was very scanty cytoplasm. Mitoses were not numerous. The blood supply was furnished by very numerous vessels of the type of arterioles. About many of these arterioles the tumor cells grew in masses of radiating rows.



## ROENTGENOGRAPHIC VISUALIZATION OF APPENDICAL PERFORATION\*

JOSÉ ARIAS AVELLÁN, M.D.

HAVANA, CUBA

AT THE suggestion of our friend, Dr. Case, we venture to offer for publication this modest contribution to radiology which at the same time serves as a demonstration of the imperious necessity of considering radiology in its proper place as a valued aid to medicine, perhaps standing first among such aids, to be resorted to always, not only in the solution of enigmas or as a recourse when all other auxilliary means of diagnosis have failed, but to correlate and corroborate the results of other investigations.

In the case which I have the pleasure of reporting, we see an excellent example of this statement that radiology should always be looked upon as the first aid in every examination.

*Clinical History.* B. F., white, twenty-three years of age, native of Spain. She has had two normal births and one miscarriage at two months six months ago. She has suffered the usual diseases of children: measles, whooping cough, etc.

*Present Illness.* The patient suffers frequently from pain in the head and very acute

pains in the shoulder and in the right lumbar region. She points to the lumbar region as the source of her pain. She does not remember having passed stones nor having observed blood in the urine. The pain has been noted every six or eight months and has lasted one to three days; but with a purgative and with hot applications in the lumbar region, relief has been obtained. At the present attack the intensity of the pain grew more acute than ever before and vomiting and nausea supervened, this being the occasion of her admission to the clinic of the Hijas de Galicia.

On examination the internist gave an opinion that the patient was suffering from renal colic, for the relief of which he ordered morphine and the application of an ice bag.

On the following day, the surgeon, Dr. Rodriguez Bas, on his visit found the patient complaining of very severe pain in the lumbar region, radiating toward the right hypochondrium, with slight muscular rigidity limited to that region. Pressure did not awaken pain in the cecoappendicular region (McBurney's point) nor in the remainder of the abdomen where there was noted slight gas distention. Temperature was  $38^{\circ}\text{C}$ . ( $100.4^{\circ}\text{F}$ .), pulse 120.

Examination of the blood showed 16,000

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leucocytes, of which 76 per cent were polymorphonuclears, 20 per cent lymphocytes, and 2 per cent mononuclears.

The patient was referred on the following day to the x-ray Department for investigation of a possible lesion of the small or large intes-

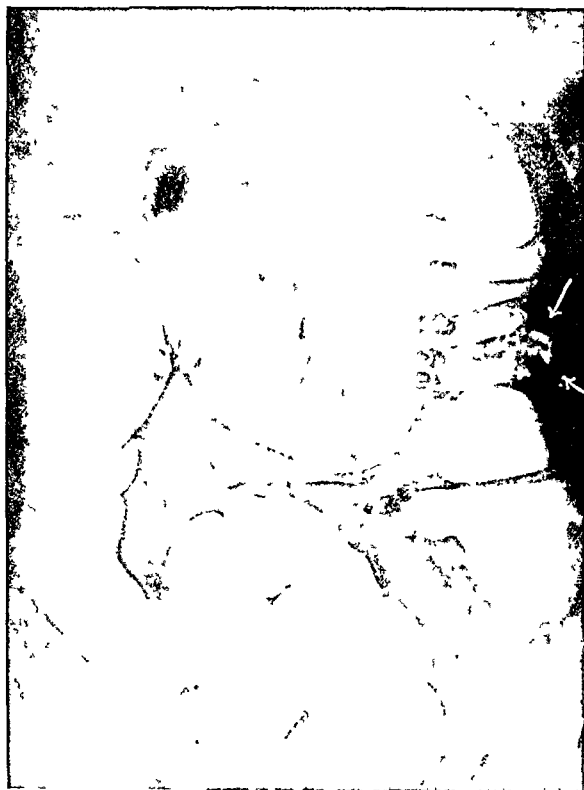


FIG. 1. Barium enema, showing at arrows barium which has escaped from perforated appendix.

Examination of the urine showed 550 c.c., containing pus cells and traces of albumin.

The patient remained in bed with ice bags, the pulse and temperature falling until they reached normal on the fifth day. The muscular rigidity having now practically disappeared, it was possible to note on palpation a deep resistance, somewhat intermittent and somewhat painful, in the right hypochondrium.

A new examination of the blood showed 7000 white cells with 48 per cent polymorphonuclears, 5 per cent eosinophiles, and 2 per cent mononuclears.

A new examination of the urine showed a specimen of 775 c.c. with numerous pus cells and traces of albumin.

*Radiological Examination.* Study of the urinary tract showed no suspicious shadows; in fact, nothing abnormal. The pelvis of the right kidney was then visualized with iodide of sodium and it was evident that the calices and the renal pelvis were normal and that the size, position and form of the right kidney were normal.

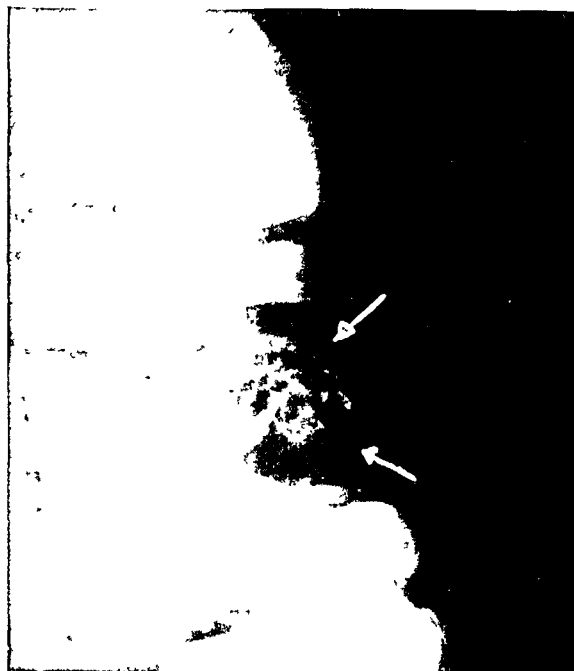


FIG. 2. More detailed roentgenogram showing clearly appendix and spilled barium in appendicular abscess.

tine. For this she was first given an opaque enema which was observed under the fluoroscopic screen. Imagine our surprise when, after the cecum had been filled by the enema, there was presented to our sight the astonishing aspect which is brought out so clearly in the roentgenograms which illustrate this paper. The cecum was high and fixed by adhesions. The appendix was large and retrocecal, filled for its entire extent, but permitting the escape through its distal extremity of some of the opaque liquid of the enema, the escaped barium being distributed in an irregular form radiating from the free extremity of the appendix. The x-ray examination was terminated with films made anteroposteriorly and posteroanteriorly and the surgeon was immediately informed that the diagnosis was acute perforated appendicitis with subhepatic plastic peritonitis.

The surgeon ordered rest, ice bags, opium, and strict liquid diet, and so twenty days passed, at the end of which time the patient was operated upon.

*Operation.* Anesthetic with gas and ether. Presno's high incision for the biliary tract, extended somewhat downward. On opening the peritoneum there was noted a small

quantity of seropurulent liquid and in addition many pericolic and pericecal adhesions fixing the cecum in a high position with the appendix extending upward along its posterior aspect. When the adhesions around the appendix had been freed, it was followed down towards its base where there was encountered a perforation about 2 mm. in diameter, extending upward toward the inferior aspect of the liver. After ligating the mesoappendix the appendix was removed with a cautery and the wound closed layer by layer, placing a drainage tube and gauze down toward the inferior surface of the liver. The patient was discharged, cured, twenty-one days after the operation.

It is quite indisputable that if this patient had been examined with the x-rays some

months previous when her only complaints were the right lumbar pains, it would have been relatively easy to have formed the opinion that the trouble was probably due to this large, long, retrocecal appendix which caused the pain to radiate into the lumbar region. This could easily have explained the symptomatology and early operation would have avoided the serious risk of life incurred by this patient.

So then permit us once more to beg of our medical colleagues that the more intimate the collaboration with the radiologists, the more surely will good results be obtained. In this particular case the patient's life would not have been placed in such jeopardy.



## CONGENITAL RADIOULNAR SYNOSTOSIS\*

WITH REPORT OF CASE

EDWARD S. BLAINE, M.D.

CHICAGO, ILL.

THIS title refers to a rare developmental fault occurring in the upper forearm in an exceedingly small percentage of individuals of the human species. The condition will be of interest to the surgeon, the orthopedist, the roentgenologist, and those who are concerned with studies in anatomical detail. Having encountered one of these unusual anomalies, my attention has been focused on the subject to the extent that it seems worth while to report the case in detail together with correlated matter bearing on the subject.

This condition has also been called "congenital pronation" because of the inability of the subject to supinate the hand; in other words, the palm cannot be turned upward because the wrist is in fixed pronation. Another term given is "congenital fusion of upper ends of radius and ulna," which describes the anatomical variant.<sup>1</sup>

Following the advent of the x-ray in the

investigation of the skeletal structures of the body, the presence of this lesion has been discovered in a number of instances but it was known in the pre-roentgen era through post-mortem studies. Apparently it was first discovered by Lenoir in 1817 at autopsy, according to Mouchet.<sup>2</sup> Prior to the discovery of the x-ray, there are records of 15 cases found post mortem and 7 in vivo, described by Abbott<sup>3</sup> in 1891. Upwards of 200 cases of this lesion are recorded in medical literature. Kienböck<sup>4</sup> in 1910 reported several cases, Baisch<sup>5</sup> in 1912 described 4 cases and referred to 38 others including those of Keinböck; Sonntag,<sup>6</sup> Lüdin,<sup>7</sup> Grashey<sup>8</sup> and Köhler<sup>9</sup> are among those who have written on this rare lesion. Boorstein in 1918 wrote on the subject.<sup>10</sup> The most illuminative presentation in English on radioulnar synostosis is the extensive article by Davenport, Taylor and Nelson,<sup>11</sup> who jointly made a most thorough excursion into various fields in the study from many angles of the 15

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cases which they found to have this lesion. in Figure 1, from which it will be seen that there is no regular pattern of occurrence.

Radioulnar synostosis is a congenital One female appears to have been affected

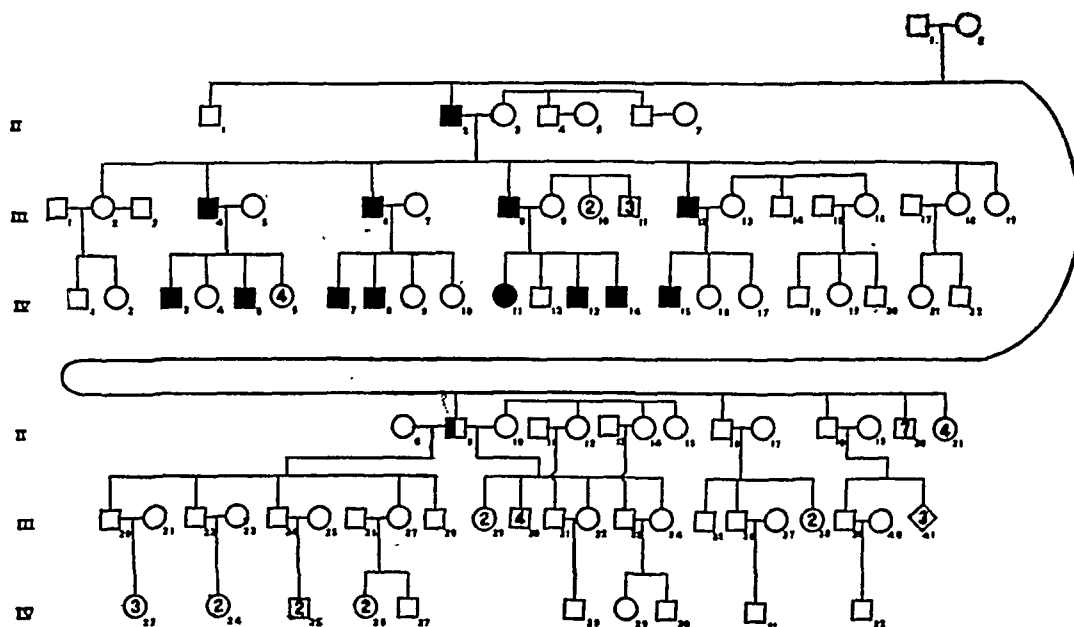


FIG. 1. Pedigree chart of M. family: Roman numerals represent generations; arabic numerals, individuals. Squares represent males; circles, females; black symbols, synostotic individuals; half-black, those unilaterally affected. Large figures inside symbols indicate designated number of that sex. Line of Generation II is carried down to second level to conserve space. (Davenport, Taylor and Nelson.)

fault which consists of the fusion of the upper portions of the radius and ulna in a greater or less degree of pronation due to which supination is impossible. The amount of fusion of the bones varies from 1 to 6 cm. in length in the reported cases. In a little more than 50 per cent of the studied cases the condition was found to be bilateral and occurred far more often in males than in females. In several of the cases it was found to have occurred in successive generations of a family line but a careful analysis of successive issues in other families in which the lesion occurred, failed to show such a familial sequence. In certain strains this peculiar synostosis appears to be of a dominant Mendelian character. The evidence seems to show that while its appearance does not exactly follow the Mendelian formula, it is possible that some complex variation of this theory may be involved. In one family investigated by Davenport, Taylor, and Nelson, they found the inheritance to be as shown

in the four generations shown and one case of unilateral involvement is indicated. The extensive involvement and sequence found in this one family is not duplicated in the pedigree charts of any of the other families studied by Davenport and his associates, who found that the occurrence of synostotic individuals in successive generations is far less frequent than is recorded in this particular family.

#### CASE REPORT

The case which came to my notice is that of A. B. C., a graduate in medicine. He is twenty-eight years of age, white, and weighs about 165 lbs. He is of robust or stocky build. His appearance is not unusual although one may note a seemingly short neck, and the upper and lower extremities appear somewhat shorter than normal in relation to the length of the body. He is in splendid health and there is no history of a major injury to either of the upper extremities. Just prior to entering school at five years of age, a minor injury to the right wrist occurred when it was first noted that

he could not turn his hand in supination. There were no untoward events in connection with the prenatal or obstetrical periods, so far as

upper, the fork being held in a vertical position. In receiving coins, etc., he cups the left hand and can thus retain the object being handled



FIG. 2.

FIG. 3.

FIG. 2. Right radioulnar synostosis (Author's case).

FIG. 3. Left radioulnar synostosis (reversed in reproduction, Author's case).

can be ascertained. No similar occurrences are known of in the two preceding generations. He is somewhat handicapped in that he is unable to rotate either of the forearms. The left forearm is fixed in a position midway between pronation and supination, that is, about  $90^\circ$ , while the right forearm is fixed in nearly complete pronation, lacking about  $15^\circ$ . This enables him to use the left hand to a much greater degree than the right. In writing he has relatively little difficulty in holding the pen and writes a legible hand. In eating he has difficulty in handling a spoon and fork with the right hand and holds these as does an infant, that is, sideways with the fingers folded around the handle. In loading the spoon or fork, the elbow is held high and then brought in toward the body to place the food in the mouth. In using the knife he has no difficulty but holding the fork in the cutting operation is a rather awkward procedure, accomplished by placing the thumb and little fingers on the under side and the remaining fingers on the

with very little difficulty. Flexion and extension of the forearms are not restricted or interfered with. Both wrists, both hands and the fingers all function in a normal manner.

An x-ray investigation of the case reveals a bony fusion of the radii with the ulnae (Figs. 2 and 3). The synostosis amounts to about 4.5 cm. on the left side and 6 cm. on the right side. The bony texture is normal in every way and the union of the two bones is complete in every way. The fusion extends to the articular surfaces which are continuous. Only the outer portions of the upper ends of the radii can be recognized but no real radial heads are present. The lower portions of the radii and ulnae show no structural changes except that both ulnae are longer than normal, thus obliterating the area of the triangular fibrocartilage which is always present in the normal. No bone or joint variations were found in the neck, upper spine, lower thighs, knees or upper legs. It thus appears that the radioulnar synostosis is the only fault present.



The type revealed in this case is the deformity found in the typical cases described by most of the authors who have reported this lesion in detail. Variants in the lesion are many. In most cases the forearms present different degrees of the pronation deformity, right and left, as regards the fixed position of the hands and lower forearms; this was true in the case here reported. In most of the cases described the integrity of the elbow joint was not altered, the articulating surfaces being smooth and regular. In a considerable number of cases there was an absence of the head of the radius, this structure being represented by no more than a rounded upper end instead of the flattened knob form as seen in the roentgenogram of the normal. This has been called the "headless type."

In seeking an explanation for this peculiar anomaly, one may consider the possibility of it being an atavistic throwback, for a somewhat similar development is found in the radius and ulna of the deer. These two bones are separate in the young deer but they normally become fused in the matured animals. One may also cite a similarity in the fusion of the several bones that form the human skull where fusion and resulting obliteration of interosseous spaces are a normal sequence with advancing years. In none of the many cases reported have I found any reference to any accompanying synarthrosis of the nearby elbow joint.

A study of the two bones involved in this peculiar bony union from the phylogenetic standpoint reveals certain aspects which may have some bearing on its formation. It has been shown that the fins of fishes are the forerunners of the body appendages in man, namely, the hands and feet. In the amphibia the number of bones distal to the humerus is reduced to two, one of which, the ulna, is posterior, containing the elbow process or the olecranon, and the other, the radius, lies anteriorly supporting the carpus. It will be noted that when a child crawls prior

to learning to walk, it acts as a quadruped and in so doing the radius is crossed in front of the ulna, but when it attains the erect posture, the plane of the lower ends of the radius and ulna turn outward  $90^\circ$ , that is, they supinate and thus assume the sagittal plane. In the ungulates, such as the horse, deer, etc., the ulna is rudimentary and, as has been noted in a previous paragraph, in the older deer the radius and ulna regularly undergo a fusion of their proximal portions. In bats, also, the radius and ulna are fused in like manner.

Embryological consideration of the subject under consideration reveals that in the earlier weeks of development of the human embryo, the arms grow outward almost perpendicular to the long axis of the torso and thus lie at right angles to it. They soon become flexed and turn medially so that the palmar aspects of the hand lie applied to the front of the chest. Thus the opposite ends of the ulna and radius become reversed in position. In this position an x-ray projection of the normal bones would present an appearance of fusion of their upper ends due to overlapping, while the distal ends, not being superimposed, would be seen to be separated. Thus there is a relatively close approximation of the upper ends of the radius and ulna at this stage and it is conceivable that certain postural pressures would cause an increased contact or squeezing together of the apposing surfaces of the upper ends of the ulna and radius which might result in a mutation fault of development, the two bones becoming blended where the direct contact occurred. Another angle of the situation will be recognized in the fact that both of these bones arise from a single precartilaginous unit in which two centers later appear, one for each of the two bones of the forearm. Thus a synostotic state normally occurs in the early embryonic stages of growth. The event of an incomplete separation of these two centers may explain the occurrence of radioulnar synostosis. This failure of sepa-

ration may or may not be an inherited trait; in some strains it appears definitely proved to have been inherited, but in other cases investigated it apparently is not a transmitted characteristic. In the case being reported the patient knows of no other such occurrence in his family antecedents. Being a physician, he has made a thorough study of the situation and thus we may rely on his statement that there is no other involvement in his family line.

It has been observed that in certain families in which synostotic individuals occurred in several succeeding generations they were all of short stature, while the isolated occurrences appeared in individuals who were not short or of the pudgy habitus.

In several instances of radioulnar synostosis, multiple cartilaginous exostoses were present, which condition seems to be related to the lesion under consideration but the connection is not closely defined. The occurrence of other bony defects such as club feet, club hands, absence of certain fingers and toes, fusion of fingers, etc., has also been noted in a number of the reported cases of radioulnar synostosis. Having these concomitant conditions in mind one may classify the lesion under consideration as in the achondroplasia group. This lesion is ordinarily considered as an inherited lesion but in the subject of this report, no other similar instance in the antecedents has been discovered, as already stated. In the group of cases in which heredity plays a part, the inheritance is always in the male line, and it is bilateral in about 50 per cent of the reported cases.

Note is made of the relatively greater occurrence in families in which there are consanguineous unions. Davenport et al.<sup>11</sup> say:

It may be remarked that a large proportion of the families we have studied at first hand are Jewish and thus belong to a race in which consanguineous marriage is relatively common. Thus, of our 13 families, 9 are Jewish, 1 German, 1 French Irish, 1 Irish and 1 English . . .

On the whole, the evidence seems to favor the conclusion that there is some truth in all of the hypotheses and that radioulnar synostosis is a trait that, in different biotypes, depends on one, two or three factors; that it is usually an autosomal dominant (although the possibility that the gene for it may lie in the chromosome of certain families should be kept in mind), and that it is partially sex limited but variable in degree of expression, possibly owing to modifying factors.

In their summary, the same authors present the following:

1. Radioulnar synostosis varies greatly in degree. Two fairly distinct types may be distinguished; (a) the type in which the radial head is absent, the proximal end of the radius being fused with the ulna, and (b) the type in which the head of the radius is displaced toward the flexor side of the arm. The extent of the bony union varies from about 2 to 6 cm.

2. A comparative review of the mammalia shows that the radius and ulna are frequently united. This union is associated partly with their close proximity, so that any overgrowth of either bone may cause a permanent fusion of the two. When the use of the anterior appendage is not seriously interfered with, this union may become normal for a species, genus or family.

3. The radius and ulna develop out of the same precartilag plate, and, at a later stage, the perichondrium of the two bones is continuous at their proximal ends.

4. The abnormal developmental impulses which lead to synostosis are indicated by other bony defects in the propositus or his family. Among the commonest of these are; exostoses, clubfoot, and clubhand, flat-foot, abnormally diminished growth of long bones, short stature and bowlegs; in general, dyschondroplasia.

5. There are genotypical differences in the various families, which thus belong to diverse biotypes. In one family (M.) only one gene appears to be responsible for the synostosis, and this acts much as though in the Y chromosome (but this is highly uncertain). In most families, distribution is that of a two-gene trait; in one of the families, of a three-gene trait. The synostosis is always a dominant trait.

6. Males are twice as likely to be affected

as females; and this result holds for bone defects in general.

7. Frequent lack of symmetry in the defect suggest that there is frequent imperfection of dominance.

8. Consanguineous matings are found in the synostotic families; and it is probable that they are especially frequent in them.

9. Radioulnar synostosis appears to be a dominant partially sex-limited trait, which varies in degree of expression.

The essayist has endeavored to find record of successful corrective treatment for this condition but in most of the cases reported in which surgical attempt was made to provide relief, the effort proved unsatisfactory. Dawson<sup>12</sup> describes an operative correction in which he speaks of having obtained an excellent result by a six-step operation covering a very extended period of time.

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## HEAD SLING TRACTION TECHNIC IN CERVICAL SPINE ROENTGENOGRAPHY\*

PHILIP LEWIN, M.D.

CHICAGO, ILL.

THE accompanying diagram (Fig. 1) illustrates a method of making roentgenograms of the cervical spine, which is useful in certain cases.

S. S., a man of thirty-eight years, was playing handball. He hit the ball and, in an attempt to get out of another player's path, rotated and hyperextended his head, neck and thorax. "Something" happened to his head, neck and chest. A torticollis developed gradually and in eighteen hours arrived at the stage shown in Figure 2. He had severe pain over the left supraclavicular and infraclavicular regions.

Roentgenograms were made by Dr. E. L. Jenkinson without and with traction as shown in Figures 3 and 4. The traction was obtained by tearing a longitudinal slit in a piece of muslin (see Fig. 1B). One-half was placed under

the chin, the other under the occiput. Both ends were pulled upon by an intern while the exposures were made (see Fig. 1A.). Note the relative positions of the elongated transverse processes of the seventh cervical vertebrae, the first ribs and the transverse processes of the first thoracic vertebrae.

The sling may be made from a strip of heavy roller bandage about 48 in. long and 6 in. wide. A linear slit about 10 in. long is made through the middle.

The treatment indicated in this case is, very briefly: head traction in bed with the head of the bed elevated 8 in. and the application of a weight of about 12 lbs., and after a few days the application of a very high Schanz collar made of cotton, bandages and adhesive.

\* Submitted for publication January 18, 1930.

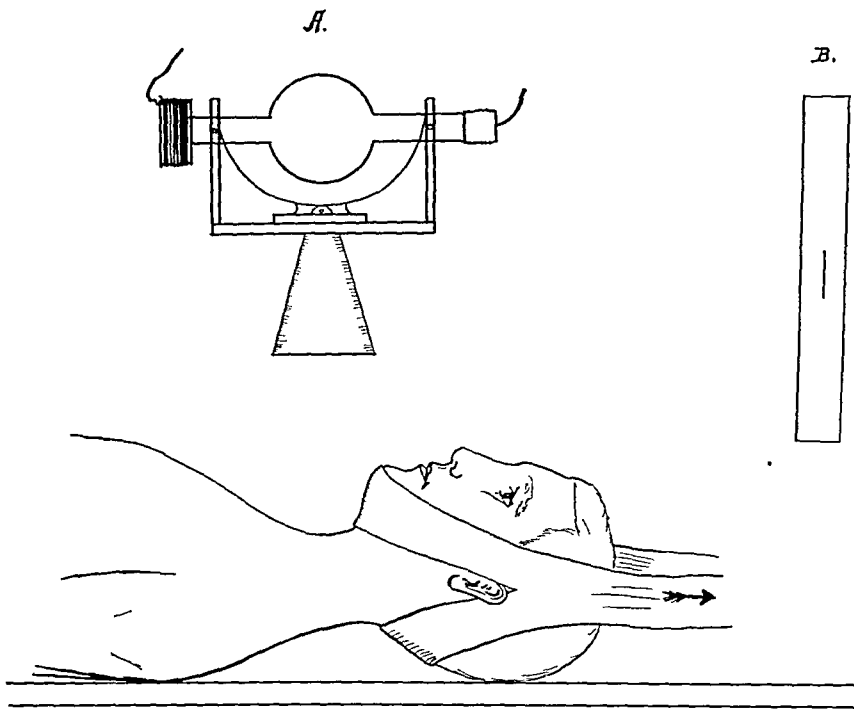


FIG. 1. A. Muslin traction in action.  
B. Strip of muslin with slit.



FIG. 2. Torticollis.



FIG. 3. Roentgenogram made without traction.



FIG. 4. Roentgenogram made while traction was exerted. A, Anteroposterior view. B, Lateral view.



FIG. 5. Torticollis corrected and Schanz collar, of cotton, bandages and adhesive, applied.



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## EDITORIALS

### THE COST OF MEDICAL CARE VS. THE VALUE OF MEDICAL SERVICE

INABILITY to differentiate between the cost of medical care and the value of medical service is costing thousands of lives and millions in money. Many who have had experience in the stock market will appreciate the vast difference that may exist between cost and value. Professional services, like some stocks, may cost a great deal and still be without value. The cost of anything is unsatisfactory unless the value is known.

The cost of medical services may be determined without a great deal of difficulty. The value cannot be estimated with similar ease. It may range anywhere from a restoration of the patient's health and vigor to a virtual death warrant. Yet the cost in each case may remain the same. For example: What is the value of a doctor's services who carefully studies a case of intestinal obstruction until it is

hopeless? What is the value of his services when he appreciates the dangers of delay and relieves the condition safely? And finally, what is the value of his services when he mistakes a diaphragmatic pleurisy for an intestinal obstruction and an ill-advised operation results in an untimely death? The doctor's charge may be the same in each case.

Let us not think for a moment that the surgeon is the only one who needs watching. The American obstetrician has the highest mortality rate in the entire civilized world. We are all familiar with the studious internist who treats stomach ulcer, curing it time after time until perforation or malignancy intervenes to put an end to the tragedy. We have met the popular society doctor who treats all comers for what they have financially. Usually he treats them for not less than \$250.00,

never hesitating to treat them for more if they have it. We must not inadvertently overlook the practitioner who takes a six weeks' vacation and returns a "specialist," reminding one strongly of Chick Sales' character described under the same title.

In the event the patient's malady is obviously surgical he is generously referred to the surgeon offering the largest rebate. Even in this line competition seems to be keen. One operator, I shall not call him a surgeon, is reported to have remarked: "There is no money in surgery any more because the referring doctor demands 75 per cent of the operating fee for referring the case." The man referring the case ignores the fact that incompetent surgery is taking a toll of human lives ranging from 10 to 50 per cent.

The cost of medical care has increased to an alarming degree in the past twenty years. As a *science* Medicine has made greater advances than the increase in cost. In the practice of the healing art such has not been the case. On the contrary the art of medicine has actually retrograded until the regular profession occupies a position only a little higher, on the average, than the irregular.

Only a few years ago Dr. Willis, of Richmond, read a paper before the meeting of the American College of Surgeons showing a steadily increasing mortality rate attending many of the common surgical procedures. He showed that the mortality rate attending goiter operations had increased 250 per cent; operation mortality rate for gallstones had increased 77 per cent; duodenal and gastric ulcer operation mortality rate had increased 72 per cent, and that for appendicitis had increased 31 per cent.

While on the average the work has become poorer the cost has at the same time increased. Cost is no criterion of the worth of medical care. Frequently the better paid, the poorer are the services.

The variation in the value of medical services is almost beyond comprehension.

As an example: Quoting from Carr and Deacon on "Appendicitis in Michigan:" "In some counties no deaths occurred. In others it varies from 1 per cent and over. In only 8 counties was it less than 5 per cent; in 11 it was between 5 and 10 per cent; in 16, between 10 and 14 per cent; in 17, between 14 and 18 per cent, and in 10, between 18 and 21 per cent. In 10 it was 21 per cent or more." This will give an average of approximately 15 per cent. Compare this, if you please, with the mortality rate of competent surgeons which does not run over 1.5 per cent. A difference of 1000 per cent between the *average* and the *good*. In other words, there is a sacrifice of more than 13 human lives in each 100 suffering from appendicitis, and an appendectomy is a simple operation! Probably one person in each one hundred has been operated on for appendicitis within the past ten years. In other words, one million people in this country have undergone this operation during that time. If there was a preventable loss of 13 in each hundred, there was a preventable loss of 130,000 in the people residing in the confines of this country during ten years; 13,000 each year, or 36 per day. This is part of the needless cost paid in the treatment of appendicitis. No wonder the average mortality shows a greater increase in the more difficult operations of gall bladder and stomach ulcer; and still greater in that attending goiter operations where the difficulties of the operation are further complicated by the patient's poor physical condition. This needless sacrifice of human life constitutes the greater cost of medical care. The cost will always be unsatisfactory until the value is determined.

At first it may not be practical that individual mortality rates be determined for general information. It is essential that each hospital have its classified results available to every prospective patient. For example: The prospective appendicitis patient has a right to know that in hospital "A" there is a mortality

rate of 2 per cent while in hospital "B," which is likewise an accredited hospital, there is an average mortality rate of 15 per cent. This knowledge may be embarrassing to the hospital with the high rate but the patient whose life is at stake has the right to know.

Members of the regular medical profession has been responsible for increasing the average length of human life nearly two decades within the past half century. Shall we sit quietly by while fanatics, irregulars and incompetents nullify this splendid work so well begun.

Human life is too valuable to be squan-

dered at the rate of 1000 per cent here and more there. The banker figures a fraction 1 per cent profit or loss. If the medical profession is going to be worthy of the confidence and trust of the people it must purge itself of the corruption and incompetency that is polluting it and costing thousands of lives.

When medical services are sold on the basis of efficiency and not by high pressure salesmanship then there will be no argument about the cost of medical care. The patient gets what he pays for and pays for what he gets.

CHARLES EATON PHILLIPS, M.D., F.A.C.S.



## CLINICAL RADIOLOGY

THE work of the radiologist is not a mere technical task of producing a set of shadow records. More than most other branches of surgical diagnostic and therapeutic performance, radiology demands a preparation for the work, requiring practical familiarity with many technical and physical facts and a multitude of details of mechanical technic. For the physician engaged in the field of general radiology including both diagnosis and therapy, the requirement comes close to that paragon, the "all round" specialist, for x-ray methods now constitute a part of the armamentarium of almost every specialist in medicine and surgery. The radiologist does well to select a certain sphere of medical investigation for his chief endeavor.

Before commencing the strictly medical part of his work the physician-radiologist must go through a more or less mechanical procedure to produce a shadow record on screen or film. To a certain extent, but never wholly, this part of the task may be sublet, so to speak, to trained technical medical and lay assistants, and the real work of the physician-radiologist begins when the shadow record has been produced. These shadows must be trans-

lated into terms of pathology and clinical medicine; and whereas a certain part of the preliminary technical labor may be sublet to assistants here the radiologist must do the work himself, and do it as a clinician if his work is to be of real value. The greater his familiarity with the clinical aspects of the case before him, the more likely is his effort to prove worth while.

Radiological work is in large measure a consultation, though we fear it is seldom considered in that dignified light. In the ordinary consultation, as carried out in daily surgical practice, the consultant is given the advantage of all the data of history, physical findings and laboratory tests available in the case up to the moment. The consultant seeks to uncover new facts and from his experience tries either to put new construction upon the interpretation or to confirm or deny the hypotheses already advanced. How rarely is this really done in radiological practice! The age and general aspect of the patient speak for themselves, if the case is one requiring the personal attendance of the physician-radiologist, but the history and other data are available usually only by special effort, which is so time consuming



that in a busy x-ray department it is seldom put forth. Many referring physicians seem loath to write down a working diagnosis on the refer-blank accompanying the patient to the x-ray department; sometimes it is not possible to give a preliminary diagnosis. But as a matter of fact, the radiologist does not need a working diagnosis; he does need to know the motive which led the referring physician to ask for x-ray study.

Father would not ask Johnnie merely to go and look in the basement; he would say, he thought he heard a noise, or felt a draft, or smelled gas, or heard water trickling, or suspected a prowler, or forgot to turn off the draft in the furnace, and he would ask the boy to look in the basement because he feared such or such a thing was wrong. Or, he might tell the boy to explore the basement, not because anything was thought to be wrong, but just to make sure all was right.

Again, Johnnie might be asked to go to the upstairs front room and look—not just *to look*, but *to look for something*. However definite or indefinite the suspicion, Johnnie would be given some idea as to why he was to look.

So, in referring patients to the x-ray department for diagnostic work, it would be extremely helpful if the referring physician would write down in a brief sentence the real reason for the reference. A tentative diagnosis is not necessary, but a phrase or a sentence acquainting the radiologist with the problem would make the latter's work more efficient and pleasant, and result in much economy of material and time.

Some problem always presents itself to the attending physician suggesting the value of an x-ray study. The radiologist needs to know what is this problem. In chest cases, is the examination suggested because of a cough? Is the cough productive or not? Is there dyspnea? Is it a pulmonary or a cardiovascular problem, etc? Is there a question of subphrenic abscess? In the latter case the technic of

the study will be very different from the usual chest examination. The same is true of suspected pericardial adhesions. Suspected rib fracture requires a special kind of radiographic study.

Of course in the case of Johnnie already cited, there may have been instituted in his home a formal routine of exploration of the house, and at father's behest Johnnie might make the complete round, checking up on leaking gas, blocked sewer, open windows, unlocked doors, leaking faucets, intruders, etc.; but what a lot of wasted effort in the average instance!

In the interests of more efficient radiological work, let us urge a closer cooperation between the surgeon and his radiological colleagues. Let him take the radiologist sufficiently into his confidence to briefly state his problem: the reason for sending the case for x-ray investigation. If, as sometimes (not often enough) the examination is being done as part of a complete physical inventory, let this be stated; the radiologist will be stimulated perhaps more than ever to extra effort to unearth some hidden and as yet symptomless lesion.

Although his duty and his pride of technical work well done require him to take an active interest in the preliminary technical work, the real function of the physician-radiologist commences with the interpretation of the shadow findings, on the fluoroscopic screen or on the films. The surgeon in his physical examination endeavors to visualize in flesh and blood the lesion he palpates. In his mind's eye he sees a cyst, a fibroid, a tubal mass, a polyp, a distended gall-bladder, not merely a tumor. Guided by the history, he interprets abdominal rigidity, epigastric and lower right quadrant pain, more or less fever, and nausea as a frank appendicitis, and in his mind he pictures the inflamed rigid appendix, possibly with fragile recent adhesion bands or gangrenous tip, and fibrinous peritoneal exudate. Similarly, the radiologist must visualize in flesh and blood what he sees in shadow: not a niche, a filling

defect, a displacement, an enlargement, a contraction, a thickening, a light or a shadow, but the actual lesions. In his mind he must picture the ulcer, the cancer, the tumor, the stricture, the cavity. This ability comes only from experience and is relatively impossible without a basis of experience in pathology or surgery. Lack-

ing this foundation, much can be done to qualify the radiologist for more efficient interpretation by working *with* him, giving him opportunity for pathological or surgical check on his findings and aiding him in his effort to practice radiology as a clinician.

JAMES T. CASE.



## INTRAVENOUS UROGRAPHY

**D**URING recent years, a number of men, including Rowntree and his associates, Roseno, Hryntschak, Rosenstein and von Lichtenberg have been striving to obtain a medium, which, injected into the circulation or administered by mouth or rectum would produce definite x-ray pictures of the urinary organs.

Up to date, most of these attempts at what we may call briefly intravenous urography, have failed, through occasionally in obstructed cases fairly clear pictures have been obtained. It was left to Dr. Swick of this city, while working with Professor Lichtwitz, and subsequently in von Lichtenberg's clinic, with the aid

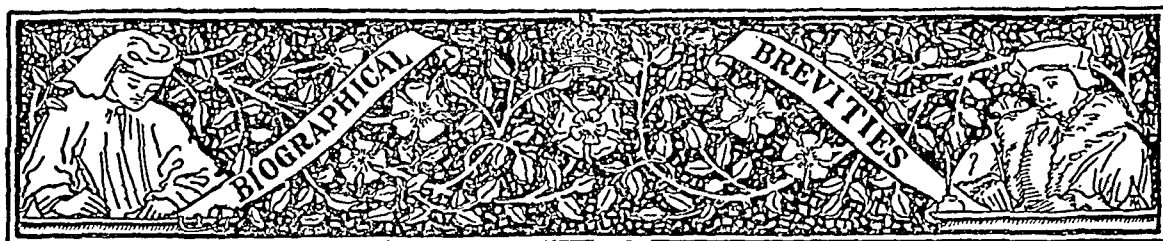
of Professor Binz and Dr. Raeth, to solve this important problem.

As a result of his work, we have an iodide compound, known by the trade name uroselectan, which, administered intravenously in non-toxic doses, produces with some regularity, strikingly perfect pyelograms, ureterograms and cystograms. The great value of this new method of exploration of the urinary tract is difficult to gauge so soon after its introduction. It is already evident, however, that uroselectan is going to revolutionize many aspects of medicine, surgery, urology, and radiology.

EDWIN BEER.



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## “BUCK’S EXTENSION”

**G**URDON BUCK was a product of New York City. He was born on Fulton Street on May 4, 1807. His father and mother were grandchildren of Governor Gurdon Saltonstall of Connecticut.

Gurdon Buck went to Nelson Classical School and finally made up his mind he wanted to be a physician. So he studied, as was the custom in those times, under Dr. Thomas Cock, and in 1830 received his M.D. from the College of Physicians and Surgeons, now a part of Columbia University. He interned in the New York Hospital. Having finished his hospital training he migrated to Europe, this being the “ultra” method of adding the finishing touches to an education, and in Europe he continued his studies in the hospitals of Paris, Berlin and Vienna for a term of two and a half years.

In 1836 he made a second visit to Europe, and in Geneva, Switzerland, married Henrietta E. Wolff of that city.

He returned to America and in 1837 was appointed visiting surgeon to the New York Hospital. This position he held until his death. He also was appointed visiting surgeon to St. Luke’s Hospital and the Presbyterian Hospital at the time of their organization. In addition, Buck was visiting surgeon at the New York Eye and Ear Infirmary, from 1852 to 1862.

He was a Fellow of the Academy of Medicine from the time of its organization, and served as its vice-president for one term. He was a member of the New York Pathological Society and served one term as president. As would be expected, he was a member of his County and State medical societies.

As a surgeon he was remarkable for his boldness in operating, and the thoroughness of the detail of his after-treatment. He was particularly devoted to fractures and spent hours in the wards of his hospitals studying this type of surgery. As a result he revolutionized the current system of treatment. The improvements he inaugurated in the then-existing apparatus are brilliant chapters in surgical history.

His method of treating fracture of the thigh by the weight and pulley was at once recognized by the profession throughout the civilized world as the establishment of an original principle of great value. To this day it is known as “Buck’s extension.”

Buck’s investigations with regard to the pelvic fascia are to be found in the first volume of the *Transactions of the American Medical Association*.

His joint surgery was especially creditable in a preantiseptic era. He excised the elbow joint<sup>1</sup> and the knee joint<sup>2</sup>. He was successful in treating edema of the glottis, and was deeply interested in rhinoplastic, stomatoplastic and other reparative operations, publishing a work of some 237 pages in 1876.

Buck was a very religious man, charitably inclined to the poor, and his sense of professional honor was Puritanical in its idealism.

He died of uremic poisoning on March 6, 1877. He left a widow, two daughters and three sons, two of whom became doctors of medicine.

<sup>1</sup> *N. Y. J. Med. & Surg.*, 1841.

<sup>2</sup> *Am. J. M. Sc.*, 1845.



GURDON BUCK

[1807-1877]

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BIOGRAPHICAL BREVITIES  
"Buck's Extension"

*The American Journal of Surgery*  
N. S. Vol. viii, February, 1930





[From Fernelius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

## ON THE ALLEGED PENETRATION OF THE HUMAN URETHRA

BY AN  
AMAZONIAN CATFISH CALLED CANDIRÚ

WITH A REVIEW OF THE ALLIED HABITS OF OTHER  
MEMBERS OF THE FAMILY PYGIDIIDAE\*

PART II

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NEW YORK

### WHAT IS THE CANDIRÚ?

THAT there are various fishes in the Amazon and its tributaries called candirús by the inhabitants of the country is certain, and that they are nuisances, blood-suckers, either as ectoparasites or endoparasites on fishes, beasts and man himself, is equally certain. Let us see what can be done to identify some of these candirús as members of the family Pygidiidae, and of the subfamilies repeatedly referred to.

The first teller of the candirú story is Martius (1829) who thinks our fish to be the young of either *Cetopsis candirú* or *C. coecutiens*, or possibly of a third unidentified species, a thing impossible of determination since his specimens of the last were lost. However, it is significant that he makes *candirú* the specific name of one of his fishes. Eigenmann (1918b) scouts the *Cetopsis-Candirú* idea for, although this fish is called by that name, it grows to

be at least a foot long and 2 inches thick. However, Martius indicates that he suspected the young of some species of this genus, and Mr. John Tee-Van collected at Kartabo, Mazaruni River, British Guiana, in 1919, a little *Cetopsis* 28 mm. long and 3.5 mm. in greatest diameter, small enough easily to have penetrated the human urethra. Presumably these fish are not parasitic, but it should be noted that the *Cetopsidae* and the *Pygidiidae* live in the waters of the Amazon and hence the young cetopsids might easily consort with and be captured along with the pygidiids.

In the search for all the first-hand information possible about the candirú, I was referred to Dr. Alfredo da Matta of Manaus, as the outstanding physician of that part of Amazonia and a man much interested in natural history. I asked him for data and his long letter to me (which will be frequently referred to) shows a large acquaintance with the candirú and

\* Part I appeared in Vol. 8, No. 1, p. 170, January, 1930.

associated fishes, and has thrown a flood of light on various points. Among other things, he thus clears up the matter of Martius's candirú:

The Candirú must not be confused with the Candirú-nassée. The Candirú is a small fish . . . without scales, of the genus *Vandellia*, family Trichomycteridae [Pygidiidae]. The Candirú-nassée, while it is also scaleless, reaches a much larger size, and is the common name of the species, *Cetopsis coecutiens*.

To return to the chronological order, the next account is from Poeppig (1836) who collected numbers of his candirú in Yurimaguas. His only preservative was the raw spirit of the country distilled from the juice of the sugar cane, and in this they unfortunately spoiled. However, examination of the figures in Spix and Martius showed him that his fish was quite unlike theirs. One can only conjecture that his candirú was a *Vandellia* or a *Stegophilus* since *Branchoica* has thus far not been taken in the Amazon basin.

Castelnau (1855) gives a colored figure of his candirú (identified as *Trichomycterus pusillus*) marked natural size. It is about 145 mm. (5.75 in.) long. This figure shows the operculum well provided with large spines. Eigenmann renames this fish *Pareidon microps* Kner, and his figures show the opercular spines fitted for holding the fish in position, while the maxillary and mandibular teeth are possibly adopted for scarification. However, its considerable size and its terminal mouth hardly adapt it for endoparasitism. It is undoubtedly carnivorous and possibly an ectoparasite, but hardly an endoparasite unless when young. It does not seem worth while to figure it herein.

Wallis (Müller, 1870) collected a candirú in the Huallagua and sent it to the Leipzig Museum where it was provisionally assigned to the genus *Trichomycterus* or to *Stegophilus*. In 1888 Leuckart loaned it to Lütken who after a careful study decided (1891) that this fish was a new form and gave it the name *Acanthopoma annectens*. The name still stands, and inspection of Lütken's figures (Figs. 1, 2, and 3 herein)

leads to the conclusion, based on the slender form, the spinous opercles, the shape and form of the ventrally placed mouth, and the teeth, that the fish (100 mm. long) is a blood-sucker, a candirú.

Boulenger's (1898a) specimens, sent in by Dr. Bach from the Rio Jurua, were found identical with those sent to Lacépède from Lisbon in 1808 by Prof. Vandelli (*Vandellia cirrhosa*) without indication of their source, but, as we now have every reason to believe, coming from Brazil. As the figures (4 and 5) show, we have here a slender fish with retentive opercular spines, with premaxillary teeth fitted for rasping and with a suctorial mouth. It is easy to believe that this "Candyrú" is also a parasite, and, as the ventrally placed opercular spines show, one not necessarily confining its operations to the gills of fishes.

After his interesting experience (see Part 1, p. 175) Jobert (1898) collected at Pará in 1877 some of the lesser candirús by the turtle-shell method, and took them to the Museum d'Histoire Naturelle in Paris. In 1911 Pellegrin examined these specimens and found them to be *Stegophilus insidiosus*, the very fish of which Reinhardt wrote so interestingly in 1859, and an undoubted blood-sucking parasite. It is shown herein as Figures 6, 7 and 8.

Next to be referred to is Pellegrin himself (1909a, 1909b, and 1911) who goes thoroughly into the structures of *Vandellia wieneri* (Figs. 9 and 10) and finds it a parasite. He analyzes the candirú stories and while he does not say that his fish is a candirú, it is plain that it is. And last comes Le Cointe (1922) who like the first candirú narrator (Martius, 1829) erroneously thinks that the fish is a *Cetopsis*. On this point see the quotation from Dr. da Matta (above). Unfortunately Le Cointe gives no figure.

Haseman, whose collecting experience (as noted previously) was most extensive, merely makes the general statement (1911a) that various species of pygidiids are given the colloquial name candirú. But Hase-

man's teacher, Eigenmann, in his great monograph on these fishes has gone more fully than any previous writer into the matter of what fishes are named candirú. He finds that, excepting the genus *Nemato-genys* with one species, all the Pygidiidae are long slender fishes, and all have the opercle and interopercle beset with patches of spines. Further he finds in addition that all the members of the sub-families Vandellinae and Stegophilinae have the mouth inferior and the gill-openings restricted. These structures, their light (even white) color, and the known facts of their habits lead Eigenmann (1918b, p. 277) to speak of the "parasitic Stegophilinae and the urinophilous Vandellinae."

Probably all the fishes called candirú by the riverines are to be found in these two sub-families only, and of the genera and species in these we may strongly suspect that *Acanthopoma annectens*, *Stegophilus insidiosus*, and the five species of *Vandellia* (especially *cirrhusa*, *wieneri* and *sanguinea*) are the fishes called candirú by the dwellers on the Amazon. *Branchoica bertonii* is also an undoubted endoparasite, but so far as now known is not found in Amazonian waters where the candirú seems most to abound. That there is here a most interesting field for study, is clear to the reader.

#### IS THE CANDIRÚ URINOPHILOUS?

This is a question that must in the final analysis be answered by experiment. But leaving for consideration in the next section the question of whether or not the alleged penetration of the urethra results from a tropism to urine or from the instinct to hide, the scanty evidence will now be presented as to urinophilism.

Martius (1829 and 1831) says that "these little fish are strangely attracted by the odor of urine." Next Schomburgk (1840) was told that penetration is especially likely to take place if urine is passed while bathing. Castelnau's statement (1855) is more direct. He says that the fishermen of the Araguay "claim that it is dangerous to urinate into the river,

because this little animal [*Trichomycterus pusillus*] springs out of the water and penetrates into the urethra by ascending the length of the liquid column." His words are "d'uriner dans la rivière." Whether *dans* should be translated *in* or *into*, indicating whether the body at the time is submerged or not, is determined by the context as given above.

Castelnau uses the word *prétendent*, and this may be translated claim, allege or pretend. At any rate he seemed to have had doubts and as the statement stands it is of course absolutely preposterous. However, there may be something to it after all. In discussing my paper with Mr. C. M. Breder, Jr., of the New York Aquarium, he told me that while collecting fishes in the Rio Chucunaque in Panama in 1924, he made the interesting observation that if any one stood on the bank and urinated into the stream swarms of *Astyanax ruberrimus*, a small characin fish averaging 3 to 5 inches in length, would collect and "would apparently try to ascend the stream of urine." Because of this tropism for urine, it was considered unwise to micturate while in bathing.

Tallying exactly with Breder and backing up Castelnau in general is the testimony of Dr. Charles C. Ammerman, a naval surgeon, who on the Madeira River in 1910-11 became quite well acquainted with the candirú. Prof. E. C. Starks; the distinguished ichthyologist of Stanford University, while studying fishes in the Philippines in 1926, met Dr. Ammerman and told him of my work on this fish. Dr. Ammerman then said that it was the belief on the river that the fish entered the urethra or vagina only when urine was passed while in the water. Prof. Starks wrote me that: "He said that if one urinated into the water, these fishes would come to the top and act as if crazy for the urine, the salt water."

These are the facts, the interpretation of them is another matter. Three possible explanations occur to me; that these fishes are tropic to urine, that they were



merely reacting to the current of water and would have so responded if water from the same stream had been poured out of a bucket or tea-kettle, and third that they were attracted by the noise. This will be returned to later when all the evidence has been presented, but only experiment can absolutely settle the question.

Several of the other authors cited in the first section of this paper indicate that penetration takes place while bathing if urine is voided. So writes Marcoy (1869), while Boulenger (presumably on the authority of Dr. Bach) says that "the fish is attracted by the urine," and Jobert was informed by his Paraense friends and by his Indians that the smaller candirú was definitely urinophilous, and this was affirmed by Dr. Castro. And von Ihering (1914) states positively that the candirú is urinophilous. The other writers quoted in the first section of this paper do not state the matter as specifically as do those mentioned, but one plainly gets the idea that all believe the fish to be urinophilous.

Eigenmann in his great monograph (1918b) speaks of "the urinophilous Vandellinae" (p. 277), and his remarks on the habits of the fishes of this family plainly indicate his belief in this particular habit. Later in his paper he establishes the inclusive genus *Urinophilus* to replace the old genus *Vandellia* with 5 species. In 1922, he names a new species of pygidiid, *Urinophilus erythrurus*, from the head waters of the Amazon. From all this it is clear that Eigenmann, the authority on these fishes, believed certain ones to be urinophilous.

So far as I know but one man has actually experimented to determine the fact. Allen (1921) writes that:

An effort was made by the expedition to confirm the widespread reputation of the candirú (carnero of Peru). A Briggs lead-in trap properly baited was frequently placed in rivers in the hope that it might demonstrate such a tropism. This was never successful.

Seeking for details of this baiting, I wrote Professor Allen suggesting that to make an absolute test of the matter it would be necessary to have a reservoir of urine discharging into the trap a steady stream, and that this urine would have to flow out of the mouth of the trap with the current, and so attract fishes facing upstream. He kindly answered that: "I merely saturated with urine rather tightly rolled pledglets of cotton and cheesecloth. These were used for bait. It may not have been as good a method as a steadily feeding reservoir of urine, but I believe that it should have answered the purpose." Whether or not candirús are known to abound in the streams where the traps were set is not stated. Certainly there is in this matter an interesting field for further experiment.

An interesting sidelight on this matter is to be found in a continuation of Mr. Breder's observations on the habits of the small characins of the Rio Chucunaque of Panama. After saying that the Indians of these parts for sanitary purposes make use of the flowing streams as sewers, and that these fishes are attracted by and feed upon human feces, he states that they are markedly attracted by flesh and blood and by human secretions in general. Specifically he added that: "In this connection *Astyanax ruberrimus*] [the small characin referred to above was noticeably attracted to the crotch and armpits of swimmers and bathers, by the abundant perspiration given off there. Here these little fishes would bite at the hairs until the men had been in the water for some time. Then when these secretions had been washed away these localized regions no longer possessed superior attractions and the little fishes distributed their tiny attacks over the whole body, particularly where there were warts, calluses, or clumps of hair on which they could lay hold." This is in accord with Martius (1831) who says: "The odor of men's secretions [he uses the plural] appears to attract the little fish."

Now it has clearly been shown above that the more specialized pygidiids are attracted by flesh and blood, that they will attack and scarify not merely the gills but the bodies of fishes, that they will attack the bodies of mammalian beasts, and that they will puncture the skin and suck the blood of man, as has been noted by Poeppig (1836), Jobert (1898) and by Haseman (1911a and b). They must be attracted to these animals, particularly to man, by the odorous secretions given off by the body. Nor does it seem too much to think that they would be attracted by the most abundant and possibly the most tropic of all, urine.

In answer to the question: Is the candirú, a pygidiid catfish, urinophilous? one must counter with the Scotch verdict: Not proven! However it seems to me that the evidence as set forth seems strongly to indicate that the candirús are tropic to urine. Additional facts to be presented in the next section also favor this conclusion. The data set forth with regard to the characins enables us to reason from analogy (a rather dangerous thing unless carefully safeguarded) but it should be stated that the characins are tropical freshwater fishes, are found in the Amazon and its tributaries, and along with the family Pygidiidae belong to the same sub-order, i.e. are fairly closely related.

#### DOES THE CANDIRÚ ENTER THE HUMAN URETHRA?

During the many years in which the accounts of this alleged habit have been accumulating in my files, I have been very skeptical on the subject. In considering the data one could not so readily apply the principle of cumulative evidence extending over wide regions and long periods of time, the principle made use of in my previous articles on "Rains of Fishes"<sup>1</sup> where the timespan was 1600 years and the region covered extended continuously from Scotland across Europe and

Asia to the South Sea Islands, with North and South America, and Africa also included.

In the present case our time span extends only from 1829 to the present day, an even 100 years. The regional distribution is likewise confined to the Amazon and its tributaries. The peoples too instead of being of diverse races are the mixed, but as such fairly homogeneous, riverine population of Amazonas, uneducated, superstitious, given to recitals of the marvellous, ready to credit the incredible. This recital shows my mental attitude on beginning the study of my materials. While these matters were being turned over in my mind I was working through the great catalogue of the Surgeon General's Library in search for further references on this subject, with the following results.

In the medical literature there are found scattering references to the penetration of the human urethra by leeches and insect larvae, and a considerable number of citations to accounts of the voiding with the urine of insects and their larvae and of worms. Without going into any discussion of the various ways in which these animate things gained entrance to the bladder and urinary passages, it may be conjectured that for the most part they penetrated and ascended the urethra and in the bladder laid their eggs which afterwards hatched and as larvae or imagos came out through the same urethra. One case of penetration by fishes was also noted: Jobert's, previously cited. Of the invertebrate penetrations and voidings it is interesting to note that 74 cases are specifically listed in this catalogue.

From this it is seen that certain elongate and sinuous invertebrates do penetrate the human urethra, but the persistent question is: Do the elongate and sinuous candirús do so?

In the first section of this paper all the known accounts, mainly from the writings of scientific men and of travellers

<sup>1</sup> *Natural History*, 607-619, 1921; and *Ann. & Mag. Natural History*, s. 10, 3: 1-26, 1920, pl. 2 text-figs.

of reputable standing, are brought together in chronological order and, on the principle that where there is so much smoke there must be some fire, they cannot be cast aside as impossible and worthless, even though individual accounts (as Lange's) are plainly not to be accepted. Let the interested reader turn to the first section and again peruse the statements made, and he will then be prepared for the evidence and argument to be set out in the next following paragraphs. This evidence is of two kinds, and the first has to do with means used to prevent the entrance of the fish.

*Precautions against Entrance.* Martius (1829) says that before going into the water the riverines constrict (tie) the prepuce with a string. Jobert (1898) had not been a day in Pará in 1877 when he was urged to follow the practice of the Tapuyo Indians and to wear the protective ligature. Later when he saw his Indian fishermen apply this and when he realized how uncomfortable it was he realized that these men absolutely believed in the phenomenon of penetration.

In his second account (1831), Martius represents the riverines as advising that "the organ be covered carefully" but gives no description of the protecting device. At the meeting of the Zoological Society of London previously referred to, Boulenger (1898a), in presenting the data on the habits of the candirú collected and sent to him by Dr. Bach from the Rio Jurua, states that the natives of this region "... rarely enter the river without covering their genitalia by means of a sheath formed of a small coconut shell, with a minute perforation to let out the urine, maintained in a sort of bag of palm fibres suspended from a belt of the same materials." Dr. Bach to make the matter clear sent to Boulenger a photograph showing two otherwise naked Indians wearing the device, but apparently did not send the device itself.

Hoping that the photograph in question was on file in the British Museum (Natural

History), I wrote Mr. J. R. Norman of the department of fishes for information and if possible for a copy. Being unable to find it he wrote Dr. Boulenger, who is now living in Belgium. Dr. Boulenger answered that "So far as I can recollect after so many years the photographs . . . were the property of the Brazilian Doctor [Bach] on whose behalf they were exhibited and were returned to him." It is greatly to be regretted that these photographs were not published and thus put visibly on record.

Corroboratory of Bach's description Prof. E. C. Starks of Stanford University writes me that he has seen a photograph of such a protective device. This photograph he thinks was brought from Brazil by the late Prof. J. C. Branner, who did much exploratory work in Brazil and knew much of the habits of the people. Search has been made through Dr. Branner's photographs but unfortunately the desired picture has not been found.

There are now to be set forth certain facts, the connection of which with the matter under discussion is not wholly clear in my mind. However, there is a strong possibility that if these matters were worked out in Brazil by a competent ethnologist, they might throw a flood of light on the subject. Hence it seems advisable to set them down.

The first of these is to be found in the book (1886) of the ethnologist, Steinen, previously referred to. On page 239 in a footnote there is a description of a penis sheath worn by the Yuruna Indians on the lower Xingu, a tributary of the lower Amazon. This is cone shaped, is cut off horizontally above and obliquely below, is made of strips of dried palm leaves, and in size is about equal to the length and diameter of the two lower phalanges of the smallest digit. This presses the corpora cavernosa back into the scrotum and causes this to swell out tumor-like. Thus the penis is entirely and the scrotum partly covered by this sheath. Earlier (p. 178) and higher up the river. Steinen had

remarked on the danger to bathers of the candirú, but here as to the purpose of this sheath he says "Atque cum urethra

men also wear a sheath. That worn on festive occasions is shown in his Figure 132, and has a flag-like appendage. This

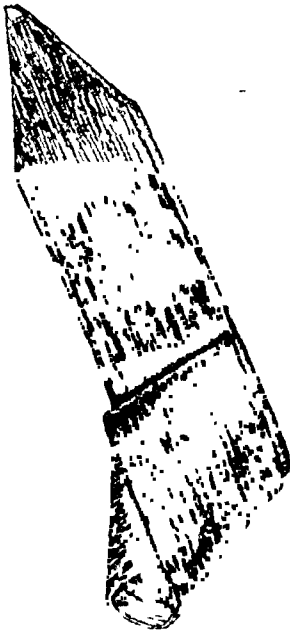


FIG. 14. *Penisstulp* worn by men of Baroró tribe on headwaters of Xingu River. It is called *Inobá* by Indians and *Gravatá* by Brazilians. Figure is  $\frac{3}{5}$  natural size. (After Steinen, 1897.)

prorsus conclusa sit, insecta intrare non possunt." This has puzzled me very much, but apparently it refers to such a matter as that referred to in the paragraph relating to citations in the Catalogue of the Surgeon General's Library.

However, the matter was somewhat cleared up when I got Steinen's second book (1897) describing a second journey in 1887-88 to the headwaters of the Xingu. In this he goes carefully into the ethnology of the tribes of this region. He does not refer to the candirú, but he does figure and describe certain devices for covering the pudenda which seem to have some bearing on our subject.

My attention was first called to the fact that in his Figures 137 and 144 men are represented with the foreskin tied over the glans. Reference to the text showed that this ligature was applied to boys on their reaching puberty. The very idiomatic language of the text is hard to translate but it is clear that the

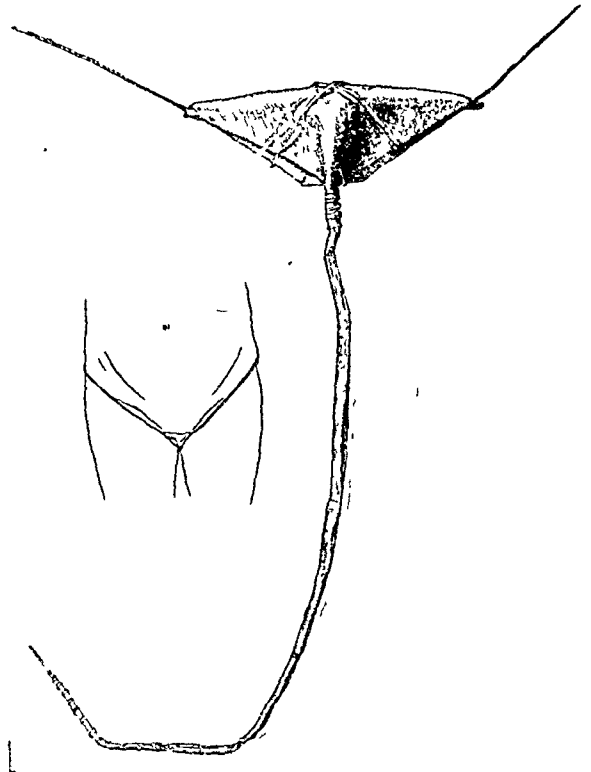


FIG. 15. *Uluri* or pudendal covering worn by Bakairi women on headwaters of Xingu River. (After Steinen, 1897.)

sheath is made of strips of dried palm leaves. The prepuce is drawn through the open point of the sheath which constricts it just as the ligature does. This is shown herein as Figure 14 and is called *Inobá* or in Brazilian *Gravatá*.

Next I noticed in his Figures 6 and 31 women also shown wearing a protective device. This is portrayed in detail in his Figure 43, reproduced herein as Figure 15. This object, called *Uluri*, is made of bark folded and tied as shown and is worn as shown in place in the smaller figure. Both this device and that worn by the men are very uncomfortable but seem to be *de rigueur*.

Krause, also a trained ethnologist, led an expedition in 1908, into the valley of the Araguana River, a tributary of the Tocantins lying between that river and the Xingu, whose inhabitants (as

will be seen) have the same general habits as those of the latter river. Inspection of the numerous figures in his book

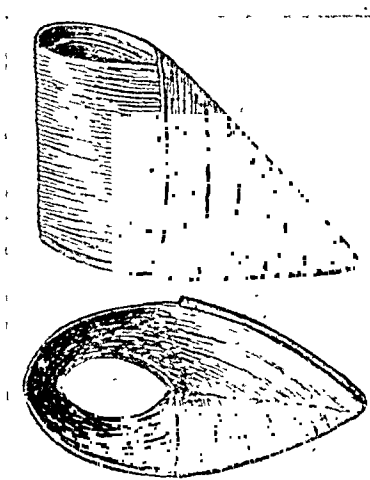


FIG. 16. Lateral and underside views of *Penisstulp* (*Imudje*) worn by men of Kanapó and Tapirapé tribes along Araguana River. (After Krause, 1911.)

(1911) showed the same ligated prepuces as portrayed by Steinen. Among the Karajá, the assumption of the penis string marks the age of puberty. This was also true of the Savajé. Some of the Karajá men also wear a penis sheath. On the other hand among the Kanapó the penis sheath is assumed at puberty. This, called *Imudje*, as shown in Figure 16 (his Fig. 217a and b), is very like that figured by Steinen as worn by the Bororó. This is drawn over the penis with the foreskin pulled forward and constricted as in the case of the Bororó also. This sheath is woven of strips of palm leaf, both by the Kanapó and the Tapirapé.<sup>1</sup>

Madame Snethlage of the Museu Goeldi (Museu Paraense) of Pará in 1913 published an account of an exploratory journey up a tributary of the Xingu and down another of the Tapajos. In the course of this trip she met many Indian men wearing the penis sheath. Her photographs show men of two tribes thus attired. Nowhere in her (Portuguese) text do I find any specific references to the plates, hence I have been unable to have any

<sup>1</sup> These proper names designate certain tribes living in the valleys of the Zingu and Araguana.

translations made of any descriptions of these objects. The objects themselves, shown in the half tones of groups of men, are so small and so poorly represented that it is impossible to reproduce them here.

What the connection may be between the constrictive ligature and the sheath worn by the tribes in these two river basins seemingly as a matter of tribal custom or as clothing, and the same devices worn throughout the rest of Amazonas as a protection against the candirú, is not wholly clear. The candirú is known and feared on both the Araguana and the Xingu but none of the explorers mentioned in this article speak of the use of these devices as protection against its attacks.

Now since tying the penis or wearing a sheath is a widespread custom among primitive peoples the world over, then why is it not widespread among the aborigines of South America? So, acting on the statement of Steinen (1897, p. 359) that "the sheath was formerly widely used throughout Brasil," I made a search with the following interesting results. Nordenskiöld (1924) briefly in his text refers to this matter, but, what is more to our purpose here, tabulates the data known to him as follows, giving references to the authorities: 26 South American tribes are known to use a penis cover, 12 to tie this organ up to a waist band, 9 to constrict the prepuce with a thread or string, 19 to use a "lap" (the "apron" presently to be referred to by Bancroft). Nordenskiöld's map shows these methods to be widely and fairly uniformly diffused over the whole of South America north of the tropic of Capricorn, but the symbols showing where the various practices are found are especially thick in Amazonas and the Guianas.

What the connection is in the use of these devices and the use of those against the candirú is not clear, but there seemingly is such. It may be conjectured that those aborigines living along the navigable waterways, and who have come in contact

with the whites, have been lead to leave off these devices which certainly are uncomfortable, and to put on the white man's clothing. However, many of them have, to the present time when going in the rivers, continued to wear the ligature or the pudendal covering as a protection against the candirús, and, in the case of the sheath, possibly against the piranhas also. However, this is a conjecture only, the matter is one for the ethnologists.

My attention has been called to Blanchard (1904) who in a short note refers to the candirú (in which he alleges disbelief) and to the use throughout Amazonas of the protective device on the penis when in the river. Then he adds:

A similar belief and a similar practice occur in South Africa, where haematuria due to *Bilbarzia* is found. It is acknowledged that this disease is caused by a parasite which lives in the water and penetrates the urethra of bathers. These natives too have the custom of covering the glans or binding the penis when they enter the water.

We figure here the protective covering used by the Zulus of Rhodesia. This interesting object, very easy to weave, has recently been brought from Buluwayo.

Figure 17 herein is a reproduction of this curious and interesting object. The American Museum has in its ethnological collections a number of these devices from Barotseland (two lie before me as I write) agreeing closely in their general makeup with that figured and undoubtedly used for the same purpose. It is unfortunate that in none of the large number of books of exploration on the Amazon that I have read, is any such object figured. Furthermore, application to the authorities of the Museu Nacional, Rio de Janeiro, for a photograph of this device, has failed to bring any information.

Finally, it is interesting here to note that, in these two far distant and absolutely unrelated regions, we have an excellent illustration of the saying of Alexander von Humboldt that different peoples in distant

countries under stress of similar necessities devise similar apparatuses or processes to attain similar ends.

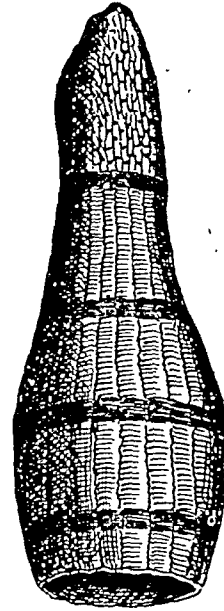


FIG. 17. Protective device against penetration by parasitic trematode (*Bilbarzia*) worn by Zulus of Rhodesia. (After Blanchard, 1904.)

#### ACCOUNTS OF PENETRATION BY THE CANDIRÚ WITH METHODS OF RELIEF

Over and above the data already set forth, valuable as they are, the great desiderata for establishing the fact of the penetration of the human urethra by the candirú are eyewitness accounts by scientifically trained men and especially by medical men. From the mass of data set forth previously, these men and their statements will now be abstracted.

Martius (1831) says that through "Dr. Lacerda [in Pará] we as eyewitnesses were made cognizant of the truth of the matter." The German has been translated literally but is not clear. The point has been discussed elsewhere, but it is certain that Lacerda believed in the phenomenon and had presumably seen a case. Whether Spix and Martius were actual or figurative eyewitnesses it would seem that they gave full credence to Lacerda's account.

On the issue in question Poeppig of Leipzig University says that Spix and Martius were "very skeptical until the

well-known naturalist and physician of Pará, Dr. Lacerda, had explained its foundation in truth." Poeppig then adds, and his direct testimony cannot be disregarded:

In Yurimaguas, I myself have been an eye-witness of such a case. An Indian woman, after the penetration by a *Canero* into the vagina suffered such frightful pain and loss of blood that she was given up to die. However, after inward and outward application of [the juice of the plant called] *Xagua*, the little fish was gotten out and the woman came through alive.

We now come to Boulenger's contribution (1898a). He had his fishes and account from Dr. Bach on the Rio Jurua (upper Amazonas). Bach had not performed the amputation of the penis, which by the testimony of nearly all writers is the only thing to be done, but he had examined an Indian man and three boys, who had been so operated on. It must be noted just here that he sent to Boulenger a photograph made by himself showing the protective device in place. From this it must be concluded that Dr. Bach believed in the penetration and the resulting operation.

However, another explanation of this matter of amputation is not only possible but also probable, and in fairness digression must be made here in order to set this forth. Reference has been made to the fact that in the same waters with the candirús there are found those active, voracious and dangerous characin fishes, the piranhas and perais. As to the habits of certain of these fishes which he calls *peri* [*perai*?] let us hear that accurate observer, Edward Bancroft (1769):

It is extremely voracious, and bites everything which hangs in the water. The feet of ducks swimming in the creeks are frequently amputated; as have been the breasts of women and the privities of men swimming in the rivers; for this reason the White Inhabitants never bathe themselves in the upper parts of these rivers without tying a napkin or handkerchief about the waist.

In this account we have two matters which plainly tie up with Dr. Bach's account as given by Boulenger; first the amputation of the penis and second the covering of the pudenda with "a napkin or handkerchief" on going into the waters of Guiana. In the rivers of this region candirús have not been found so far as can be ascertained by a diligent search through the literature. Furthermore I am corroborated in this by Mr. John Tee-Van, to whose work in British Guiana reference has already been made. He has worked on the fishes of that region, and is thoroughly conversant with the literature of Guiana fishes. In this matter he has made inquiry of the Surgeon General of British Guiana, who writes that in the medical records of the colony there is no account of the candirú.

However, the books abound in accounts of mutilations by piranhas and similar stories have been communicated to me in letters from men who have explored in tropical South America, and in all these there is no lack of recitals of amputations of fingers and toes by these voracious fishes. Furthermore, Mr. Breder has personally related to me that while in Panama on the collecting trip previously referred to little characins would collect around the men hauling the seine and would nibble at their fingers, their breasts, warts, moles, or any slight projections of the skin. They were too small to do any particular damage, only occasionally drawing blood, but they showed the characteristic traits of these carnivorous fishes. These small characins were perfectly fearless in attacking men in the water but were very wary when an effort was made to enclose them in a net.

Dr. A. Hamilton Rice of New York City, an Amazonian explorer of long experience and wide knowledge, has kindly communicated to me incidents of the voracious habits of the piranhas of which he has personal knowledge. Omitting the scores of heresay accounts for which he could not personally vouch, he states

that: "I have seen most deplorable results of mutilation by the piranha, and my own men have from time to time suffered from attacks of these fish." Of the fish itself he writes: "The piranha is a voracious blood-thirsty fish of a foot to 20 inches in length, not unlike a tautog in conformation, and with jaws similar to a circular saw in power and sharpness." He notes that it is so fierce and fearless that it will leap nearly a foot out of the water to attack a man. Omitting all accounts of mutilations by it other than that of the penis, he states that he knew of a man whose organ was thus amputated and who died of the resulting hemorrhage. Of another case we will quote his own words:

In May, 1920, at the Portuguese Beneficente Hospital in Manaus, I saw a boy of ten or eleven years of age whose entire penis had been snipped off. He had been in bathing in a river at a spot where the water reached only to his knees. A piranha jumped suddenly, seized his penis, amputating it at the base.

Along the same line Dr. Alfredo da Matta of Manaus kindly writes me that among other cases of accidents by piranhas treated by him was that of a boy who had part of the corpus cavernosus of the penis torn away by one of these fierce fishes.

With this possible explanation of the matter of amputation, we will now return to the question of penetration by the fish, in order to present the remainder of the evidence. In the discussion which followed Boulenger's presentation of Dr. Bach's data, the point was evidently raised as to whether the fish was small enough and the human urethra large enough for such penetration to be possible. This query was met by Boulenger (1898b) in the following note read at the next meeting of the society:

In order that I might satisfy myself as to the possibility of the small fish, *Vandellia cirrhosa*, penetrating into the human urethra, Prof. C. Stewart kindly took me to St. Thomas's Hospital . . . when I was able to introduce without difficulty a No. 12 catheter,

5½ mm. in diameter, into the urethra of a male subject lying for post-mortem examination. The calibre of the fish being only 3 to 4 mm. no doubt can be raised as to its ability to enter the orifice of the urethra in the manner that has been described by various travellers in Brazil.

In this connection it is of interest to examine Cuvier and Valenciennes' figure of their fish which they state was "deux pouces neuf lignes" (2.75 in.) long. An outline drawing of their figure is shown herein in *natural size* (Fig. 4). Eigenmann examined two specimens of *V. cirrhosa* measuring 94 mm. (3.75 in.) and 40 mm. (1.6 in.) respectively. The smaller of these could certainly penetrate the human urethra.

Jobert (1898) thus quotes Dr. Castro of Pará, whom he describes as "a physician of high standing and a man much interested in natural history," as saying:

I firmly believe in the possibility of such an accident because I have myself extracted from the urethra of a negress a little candirú which had penetrated during micturation while bathing in the river. The patient experienced cruel suffering for, since I had to drag the animal out, the mucous membrane was lacerated and the extraction was difficult.

Another eyewitness is Le Cointe (1922), who after discussing the danger of the penetration of the urethra by the fish says: "I have personally known already three cases of this curious accident."

Le Cointe's book is based on first hand knowledge of the natural history of Amazonas. Furthermore when I was beginning in 1925 to put into definite shape the data for this article, the well-known entomologist, Dr. Joseph Bequaert of the Harvard School of Tropical Medicine returned from an expedition to the Amazon basin. I asked him if he knew anything of the candirú, and he referred me to Le Cointe's book. He said that Le Cointe had had thirty-five years' experience in the study of the fauna of the Amazon valley, and that full credence could be given to his book. He further suggested



that I write Le Cointe for details of his experience with the candirú. This I have done, and have permission to quote from his letter as follows:

During my very long sojourn in Amazonia (since 1891) I have been able to satisfy myself that . . . the candirú is really able to penetrate into the anal or vaginal cavities of men or women bathers. Its introduction into the vagina is the most frequent phenomenon, appearing moreover to be always provoked by the imprudence of the victim in urinating in the water where she is bathing.

At the time of occurrence of one of the three accidents of this kind of which I have had full cognizance, it was incumbent on me to become a party in the matter. The thing happened on the upper Beni (in Bolivia). An Indian woman, belonging to a party engaged in the exploitation of rubber which I was directing at that time (1891), took her bath in the river and feeling herself wounded tried to extract with her hand the candirú which had already penetrated almost entirely into the vaginal cavity and which spreading out its fins [gill-covers] armed with pointed spines resisted all her efforts, wounding her profoundly. Then they brought to me this woman who was bleeding profusely. Quickly recognizing what the trouble was it was necessary for me to push the candirú forward in order to disengage the spines driven into the flesh, then to turn it in order to bring the head to the front. It goes without saying that such an operation, performed without appropriate instruments, provoked a violent hemorrhage. The Indian woman suffered greatly but she had the good fortune to recover completely in a month.<sup>1</sup>

A letter sent last year (1929) asking Le Cointe if any further data on the fish had come to his attention brought the word that there had not. However he passed my inquiry on to Dr. Americo

<sup>1</sup> It may not be out of place here to add two other methods of treatment for the candirú. Marcoy (1869) says that the 'native' Ucayali doctors know of but one remedy, which consists of a *tisane* made with the *genipa* or *buitach* apple, and which taken very hot acts, they pretend, on the urinary passages and dissolves the animal which obstructs them. And as to treatment Steinen (1884) simply says that "If a hot bath does not bring the disturber out, then the only thing left is an operation," i.e. amputation in the case of a male.

Campos, a practicing physician in Pará and a professor in the medical school there. Dr. Campos, who had lived for a long time in Abydos on the lower Amazon, writes as follows:

I have made no personal observations on the subject of accidents caused by the "Candirú." A lady whom I knew at Obidos, Dona J. S., told me that a candirú entered her vagina and that it was necessary to call in a doctor to get it out. At Obidos, Santarem, and Alenquer I have heard various instances spoken of where the candirú has penetrated the ear, the nose, the anus. It is a fact that this supposition and this fear are common in the localities cited above.

Professor Starks has communicated to me the further testimony of Dr. Ammerman (the U. S. naval surgeon quoted on p. 445) on this matter of penetration. I have been unable to get in touch with Dr. Ammerman, and so have here to quote from Professor Starks' letter.

Dr. Ammerman said that he had spent considerable time in 1910-11 on the Madeira River. I asked about the candirú and he answered that he had operated for it two or three times . . . In one instance he tried to pull a fish out of a patient's penis but the tail pulled off and he had to operate, making a supra-pubic opening into the bladder to remove the fish which had penetrated into that organ.

Finally I am privileged to quote from Dr. Alfredo da Matta of Manaus, who has been referred to previously. He writes that the candirús are well known in his region, living along inhabited shores, in clear ("white water") streams (i.e. the Amazon, etc.), but are found less abundantly in "dark or clouded water" ("black water" streams), the Rio Negro and others. They are greatly attracted by blood. "For this reason they attack women who are menstruating, during the catamenial period, when they are washing their clothes." He then gives me the following account of a case in his own practice:

Two cases of accidents due to candirús are as follows. The first concerns a girl who, while

menstruating, went naked to bathe herself in the Cambixe, Rio Solimões. The girls were in the habit of staying quietly in rather shallow water, only their heads out of water, and thus bathing themselves. This is what she was doing. The candirú introduced itself part way into the vagina, causing a hemorrhage when it was pulled out, and a subsequent severe inflammation. This operation requires some caution and skill because if, in order to withdraw it, the candirú is caught by its tail or by its body it expands its dorsal and ventral spines into the tissues, which fix it there more firmly than ever. The girl had to stay in bed some days.

The other case was told me. It was that a candirú had introduced its cephalic parts into the urinary meatus of a fisherman who, naked, was working in the water in the Rio Solimões, at Boa Vista. This was pulled out without difficulty or danger. Other accidents are told of, but I do not have entire confidence in them.

Here then is the evidence of actual experience by a modernly trained, scientifically minded physician, whose word cannot be doubted. However, before "summing up," as a lawyer does his case, it will be of interest to note in what relative numbers men and women have been recorded as attacked by the candirú. Most of the accounts do not distinguish sexes, but a few do. Bach's report through Boulenger (1898) was that on the upper Jurua he had seen one man and three boys with amputated penes, but the absolute reason and method of amputation is not specified, and it is at least conjectural that this may have been done by piranhas. For attacks on women we have better evidence. Poeppig (1836) personally witnessed such an accident. Castro told Jobert of numerous cases (probably hearsay accounts) in the Amazon basin, but personally operated on one woman. Le Cointe says that both men and women are attacked, the latter more frequently, and in his letter describes his operation on a woman.

So much for the published accounts. The data now to be given has come in personal letters to the present writer and

is quoted by permission of the writers. Dr. da Matta has just been quoted for both sexes, but indicates that women are most subject to such attacks.

Professor Allen of the University of Kentucky writes that: "The Peruvians have a larger fish, which they say attacks women. I found the Peruvian men rarely entering the river, the women never. This was more due to fear of the *carnero* (candirú) than the *pañá*—*piranha* of Brazil." This account is corroborated by Mr. W. K. Pearson of Indiana University who writes of the Rio Beni (one of the headwaters of the Amazon) that: "None of these [candirú] stories related to attacks on males. The female is apparently the only one attacked in this region. It is certain that anything but the very young of the *Urinophilus erythrus* would be too large to enter the urethra of a man." On p. 178 Mr. Pearson is quoted for a hearsay but very vivid account of such a penetration in the case of a woman.

The preponderance of accounts of the penetration by the candirú in women over men has of course its explanation based on the comparative anatomy of the genitourinary organs in the two sexes. In men the orifice is open at micturition, and then very narrowly. In women in bathing or sitting in the water washing clothes the vulva is apt to be open and the vagina being a much larger orifice than the urethra, penetration of this is comparatively easy.

In this connection the observations of Breder on the small characins of the Rio Chucunaque, Panama, cast an interesting sidelight on the phenomenon in question. Account has already been given elsewhere of the fearlessness of these little fishes and of their ferocious attacks on moles, warts, nipples, calluses, and tufts of hairs of persons in the water. The Indians defecate in the streams, wading out into water up to their waists, or squatting down until the water reaches the waist line. Around such persons the little fishes collect in swarms, making

tiny attacks on every projecting part of the body. The genitalia of the women are particularly attacked and it would seem that this would be unbearable but the stolid Indian women seem to pay no attention to it. Let the places of the characins be taken by the equally small and carnivorous but also secretive and urinophilous candirús and the seeking of a hiding place in the vagina would easily follow.

In working up this data, it has forcibly struck me that no cases of penetration of the rectum are on record. One would think that the candirú in seeking a recess to creep into would not overlook such an orifice as this even though more or less closed. This matter may, it is true, negatively indicate urinotropism. Most of the writers quoted speak of penetration of the secret openings of the body, speaking almost invariably in the plural. However, Schomburgk speaks specifically of alleged penetration of the rectum, and Le Cointe says that it penetrates the anal opening, as does Dr. Campos also.

Again there are no records known to me of the candirú's having penetrated the urinary passages of such large fishes as the Pirarucu and the huge catfishes of the Amazon, or the urethra and bladder of alligators and turtles among reptiles, of the dolphin and the manatee among water mammals, and of the terrestrial tapir and domestic cattle and horses when bathing in the river. However, in explanation it may be said that we have no accounts of such dissections of these animals as would reveal the presence of the candirú. There is certainly an opportunity here for interesting research.

From the data set forth and carefully analyzed in the preceding pages, the reader must make up his own mind as to the credibility of the widespread belief in the Amazon basin of the penetration of the human urethra by the candirú, a slender catfish of those waters, of secretive habits, having patches of hooks on the gill-covers and the back of the head, a suctorial

mouth on the under side beset with rasping teeth, having much restricted branchial openings and a short straight stomach and intestine: all these things fitting it for holding fast, rasping the skin, and sucking the blood of its host. On the bare face of the matter it seems absolutely incredible, but so does many another matter, either in ichthyology or medicine, to which our minds are not accustomed. As Prof. W. K. Brooks of the Johns Hopkins University used to say to his students: "It is not safe to say that a thing, no matter how improbable it may seem to you, does not exist because you have never seen it."

There is herein set forth a great mass of testimony bearing on the phenomenon from 1829 to 1929, and the very mass of this testimony backed by the names of the testifiers is impressive. In 1831 Dr. Lacerda, a physician of high standing in Pará, a friend of Spix and Martius, made it as clear to them as if they "were eyewitnesses." The positive eyewitness testimony of Professor Poeppig of Leipzig University is prime evidence. Dr. Bach was evidently sincere in his testimony, which seemingly convinced Boulenger. Jobert testifies to the high standing in Pará of Dr. Castro, who asserts that he operated on a case of penetration. Next we have Le Cointe, who says that he has known personally three cases of penetration and who describes one operation which he performed. Dr. Ammerman testifies that he operated for candirús two or three times, once extracting the fish from the patient's bladder. There are the accounts mentioned by Dr. Campos of the medical school at Pará, to which he evidently gave some credence since he was kind enough to transmit them. And finally there is the testimony of Dr. da Matta of Manóas of a case in his own practice.

It seems to me that this evidence is sufficient to convince a jury in a court of law, and I cannot withhold my belief in it.

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## BOOK REVIEWS

THE PHYSICIAN THROUGHOUT THE AGES. By Arthur Selwyn-Brown. N. Y., Capehart Brown Co., 1928.

For the publication of these two massive volumes little excuse is to be found. The foreword is preceded by a picture of the Editor and followed by James Whitcomb Riley's poem "The Doctor." Chapter 1 is headed "Primitive Medicine and the Medical Man; Antiquity and Universality of Disease; Paleopathology Supplies Interesting Evidence" and from there on scissors and paste are used to fill two volumes of over 800 pages each, 12 by 9 inches, double column. Articles are duly credited to their authors but not always to the place of original publication. It is not quite clear for whom this work is intended. Many of the pages read like the daily tabloids, others are fairly scientific. If the idea was to present a complete history of medicine, either popular or scientific, then it may be said that this has been much better done in many other volumes. Taking the books at random we find Chap. xvi in Volume 1 on "Rise of the Medical Libraries, Foundation of Scientific Biology" and we see a black-face headline reading "Alexandrine Libraries Exert Vast Influence," followed by this illuminating paragraph: "The libraries played a great part in diffusing medical and scientific knowledge, and none appears to have exerted more influence than the great library at Alexandria." Other headlines read "Aristotle Skilled in Dissection" and "Aristotle, the First Scientific Biologist." Opening Volume II at random we come to Chapter xli headed "Death and its Significance, Immortality Revealed by Anesthesia," a headline that must be the envy of the editor of every sensational newspaper. We also find such headings as "Fear of Death is Baseless" and are suddenly confronted with a portrait with the caption "Julius Wagner-Jauregg, M.D., Noble Prize Man (*sic!*) in Medicine, 1927." Another heading reads "Fatalism, Irony, and Charity" and right after this we find "The Biology of Death" by Raymond Pearl, M.D. A book of surprises if there ever was one! Book ix has the title "The Doctor as an Adventurer in Literature and the

Arts: A Galaxy of Able Writers" and here is reprinted "Man's Redemption of Man: An Inspiring Essay, by William Osler, M.D." No reference to previous publication or permission to republish is made. It would have seemed good taste to mention its earlier publication and not to create any possible impression of its being written for this work which was published nine years after Sir William's death. In the following pages are such headlines as "True Until Death," "Professor Coue Anticipated," "Were the Mules Responsible?," "A Mental Teaser." There is much more that is amusing and even irritating in these volumes.

There is also a little wheat among great quantities of chaff. The bibliography on page 812 contains the following paragraph: "This bibliography has been compiled to guide students to sources for augmented reading. Most of the books cited contain bibliographical references which will lead to further and ultimate sources whenever more exhaustive studies are required. Unfortunately, medical history has been a neglected study and its source materials are rare and are confined to a few of the larger European libraries." This statement will probably be a surprise to those who have access to such libraries as the Surgeon General's, those of the New York Academy of Medicine, the College of Physicians in Philadelphia, the John Crerar Library in Chicago, the Boston Medical Library, to say nothing of the new William Welch Library, in Baltimore. Perhaps, however, the statement is not so surprising when it is noted that one looks in vain for the names of such modern historians as Sudhoff and Garrison, to say nothing of many others. We find the index headed "Index and Chronology of Distinguished Physicians and World-Known Authorities." This is followed by the "Index of Subjects" in which we find such citations as "Arabs Were Mentally Keen," "Bible Story Illustrated, A," "Libido, The Ego Displaces the," "Numerology Still Used in Medical Practice" (turning to this reference we find it discusses the use of numerology by the Arabs). As said before, the work has its amusing as well as irritating side and not the least of these is its price—\$25.00.



SUPPLEMENT TO

# The American Journal of Surgery

## A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM

EDWARD M. LIVINGSTON, M.D.

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# A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM

## SECTION I. THE CAVITY (*Continued*)\*

### B. THE FLOOR, OR PELVIS

The Anatomical  
vs. the Functional  
Abdominal Floor

THE abdominal cavity, strictly speaking, has no floor for its lowest limit is simply an arbitrary anatomical boundary, the pelvic inlet or brim of the true pelvis (see Fig. 13). The interest of the surgeon is in the functional floor of the abdomen. This consists of the pelvic bones, the pelvic viscera, and that muscular sling known as the pelvic diaphragm (see Fig. 14). The contraction of this pelvic diaphragm (two pairs of thin muscles, the levatores ani and coccygei) as that of the true diaphragm, plays an important rôle in producing changes in intra-abdominal pressures and the pelvic floor supports abdominal as well as pelvic organs (see Fig. 15). The abdomen proper, then, ends as an opening or space, bounded anteriorly by the symphysis pubis and pubic crests, posteriorly by the sacral promontory and laterally by the iliopectineal lines; and the word pelvis (L. a basin), when used without qualification refers to the pelvis minor, i.e. that portion of the body cavity situated below the plane of the inlet.

The Abdominal  
Surgeon and the  
Pelvic Diaphragm

There are many reasons why the pelvic floor is of special interest to the abdominal surgeon. Its orifices provide avenues through which he may examine, digitally and instrumentally, the lowest regions reached by peritoneum (rectal, vaginal, sigmoidoscopic and cystoscopic examinations): discharges

\* With the January, 1930 issue, p. 193 began a study of the abdominal cavity as an empty space, i.e., as simply a container for the organs upon which the abdominal surgeon must operate. The roof of the cavity, the diaphragm, was investigated and as the embryology, anatomy, and physiology of this structure were reviewed, minute consideration was given to clinical points, the interpretation of which was dependent upon peculiarities in the arrangement and function of the diaphragm.

through these orifices are important in the diagnosis of pathological conditions within the abdomen (clay-colored and frothy stools, melena, azotorrhea); reflex phenomena of

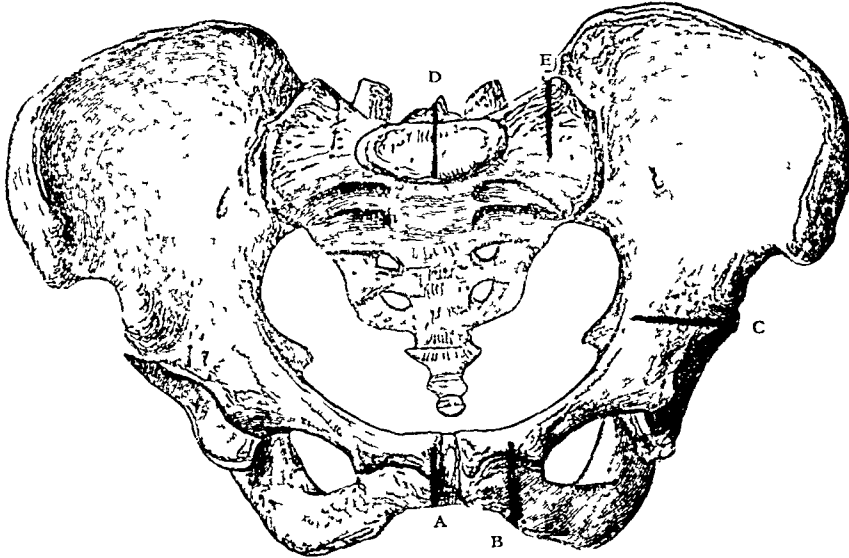


FIG. 13. Lower anatomical boundary of abdomen. Pelvic inlet.

A. Symphysis pubis. B. Pubic crest. C. Ilio-pectineal line. D. Sacral promontory. E. Ala of sacrum.

importance in abdominal differential diagnosis may be present in the region of the pelvic outlets (pruritus, spasticity; viscerosensory and visceromotor phenomena); venous congestion within the rectum (internal hemorrhoids) is often indicative of portal obstruction; infections and foreign bodies reach the abdomen through the orifices of the pelvic floor (pneumococcus and gonorrheal peritonitis; rectal foreign bodies); and the anus provides an ideal approach for the administration of fluids, food and medicines in the treatment of various intra-abdominal diseases; furthermore, the abdominal surgeon must study the anatomy and physiology of the anus and rectum to be able to create a permanent inguinal or abdominal colostomy which will perform its tasks in a manner which is adequate and satisfactory; in addition, the pelvic route may be employed for the drainage of collections of pus which have



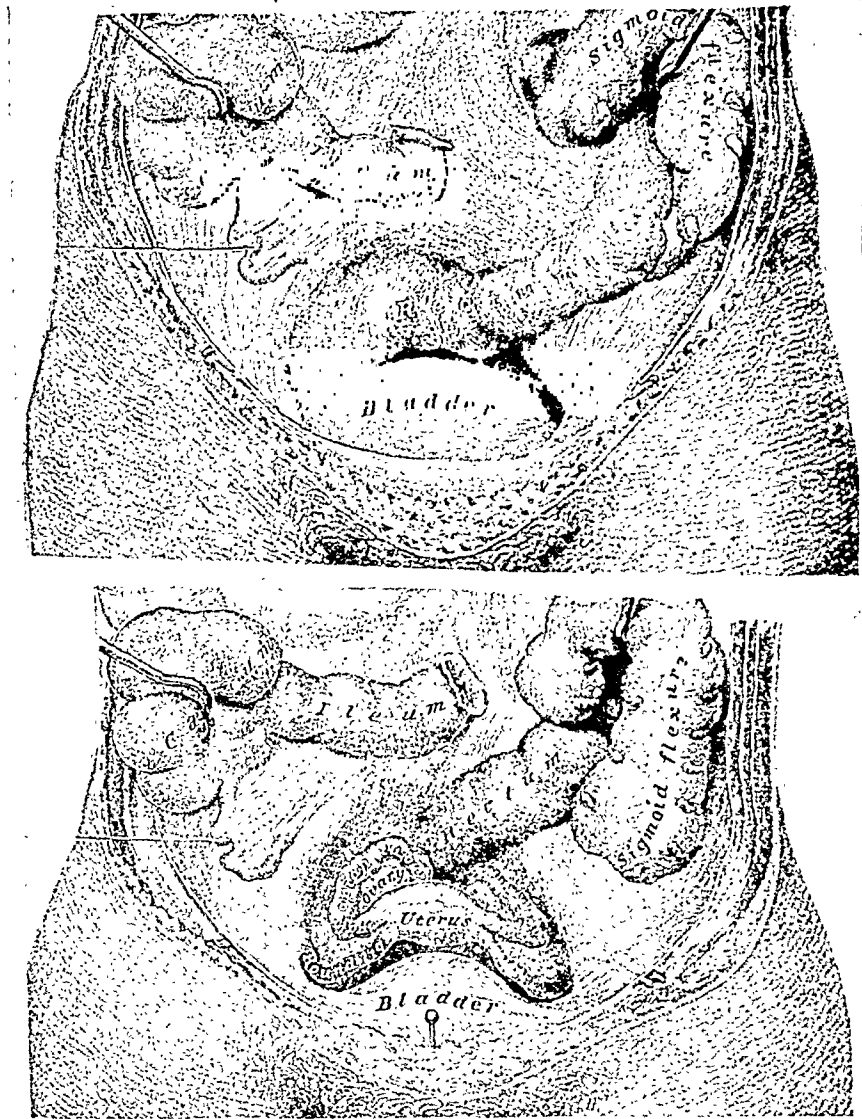


FIG. 14. Functional floor of abdominal cavity, consisting of (1) pelvic bones, (2) pelvic viscera, (3) pelvic diaphragm. Showing lowest reflections of peritoneum. (After Weisse.)

A, Male. B, Female.

gravitated from the abdomen to the lowest reflexions of peritoneum.

The importance of the anus for diagnosis is well expressed

Pathological Processes in the Pelvic Peritoneal Pouches

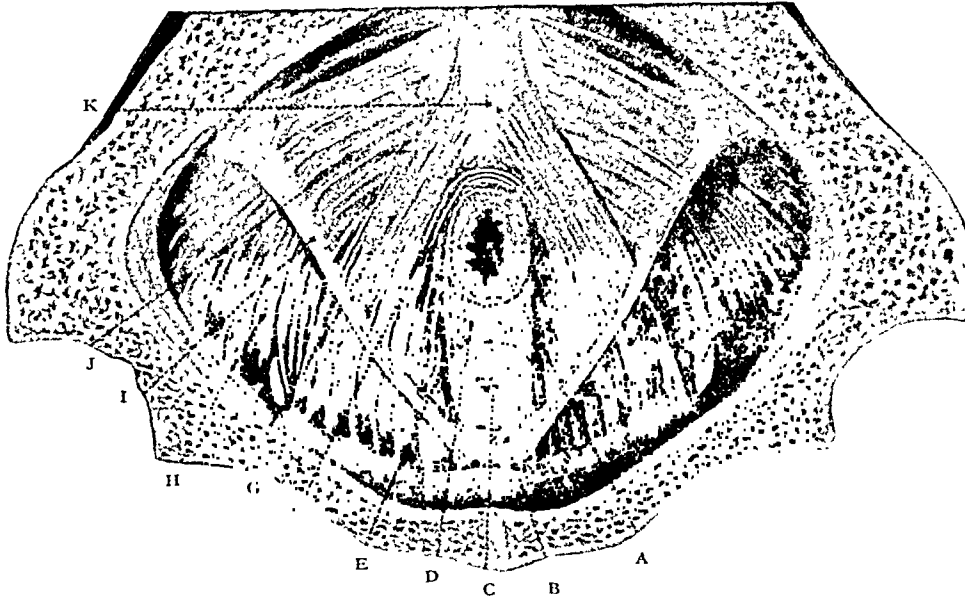


FIG. 15. Pelvic diaphragm. (After Cunningham.)

A, Rectum. B, Median pubo-prostatic ligament. C, Prostatic urethra. D, Central point of perineum. E, F, G, Parts of pubococcygens muscle. H, Obturator internus muscle. I, Arcus tendineus. J, Iliococcygens muscle. K, Anococcygeal raphe.

by the statements that “a finger within the rectum may yield more information than a thermometer within the mouth,” and that “the difference between the general practitioner and the surgical consultant is this: the consultant does not neglect the rectal examination”; again, by the somewhat less elegant expression that “the diagnostician who fails to put his finger into the rectum very often puts his foot in it.” By examination through the anus (*L. annus*, a ring) it is possible to detect the tenderness of acute inflammations, to locate adhesions which have fixations to the rectum, and to palpate masses located within or pressing upon the rectal walls. Within the perirectal reflexions of peritoneum (pouch of Douglas); rectovesical and lateral or pararectal pouches) there may be discovered abnormalities such as the prolapse of abdominal

organs, or local collections of blood, pus, or malignant tissue (see Fig. 16).

#### Reaching the Peritoneal Pouches

Due to the elasticity of the pelvic floor the surgeon may

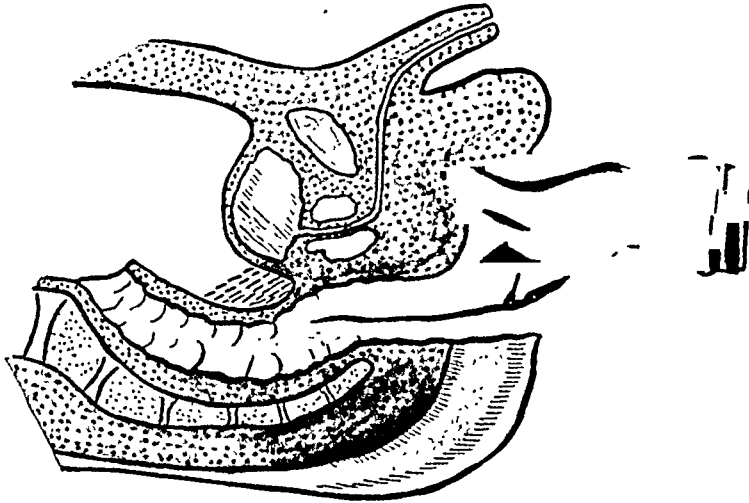


FIG. 16. Rectal examination. Palpating rectovesical pouch. In this case a collection of pus is shown in the pouch. (From Bailey.)

reach further into the rectum than the normal 3 to 4 inches representing the length of his index finger. A slow, steady upward pressure allows considerable inversion of the pelvic diaphragm and this may carry the examining digit to a point from 1 to 1½ inches higher within the canal. The normal height of the rectovesical and rectouterine pouches varies considerably. As a rule, with empty rectum and bladder, the fold of peritoneum upon the anterior rectal wall comes to 2 or 2½ inches from the anus (1 inch or 2.5 cm. above the base of the prostate);<sup>18</sup> i.e. opposite the level of the fifth sacral vertebra. When the rectum or bladder is distended the reflexions of peritoneum lie considerably higher and may extend well beyond the reach of the palpating finger. In a child the pelvis is shallow while the peritoneum is reflected to much lower levels than in the adult, both factors contributing to the ease with which the lower abdomen may be reached during childhood.

It is important to be both gentle and deliberate when performing a rectal examination, if most is to be gained from the procedure. The extreme distance to which the digit may be passed when the patient has been anesthetized—(whether by a general anesthetic or by spinal or caudal nerve block) illustrates the advantage in securing muscular relaxation. The patient is warned not to strain but to lie quietly, breathing with the mouth open; and is informed as to exactly when the examination is about to begin. The finger is best held firmly against the anal verge until the sphincter is felt to yield, rather than thrust forcefully into the rectum. The finger, gloved and well lubricated throughout its entire length, is introduced very slowly and with a slight rotary movement. The presence of hardened feces renders the examination unsatisfactory and if these are encountered the procedure is best deferred. The novice has at times, mistaken the uterine cervix or fundus, felt through the rectal wall, for an ulcer or a new growth. It is well, when examining the female, to identify the uterus before searching for other structures or pathological conditions. The examination should be conducted systematically, "synchronizing the mind and the finger." Local inspection of the perianal region with the aid of a good light should be the initial step in every examination. The actual palpation may be carried out as follows:<sup>19</sup>

- |   |  |                                      |
|---|--|--------------------------------------|
|   | { <div style="display: inline-block; vertical-align: middle;">           1. Prostate, right lobe, left lobe.<br/>           2. Right seminal vesical; left vesical.<br/>           3. Rectovesical pouch.         </div> |                                      |
| In the male   |  | Anterior wall.                       |
|   |  | Left lateral wall; pararectal pouch. |
|   | Right lateral wall; pararectal pouch.  |                                      |
| In the female   | Superiorly, as far as can be reached.  |                                      |
|   | Posteriorly; hollow of sacrum; coccyx; pyriformis muscle.  |                                      |
|   | Cervix.  |                                      |
|   | Pouch of Douglas.  |                                      |
|   | Left lateral wall.   |                                      |
|   | Right lateral wall.  |                                      |
|   | Superiorly, as far as can be reached.  |                                      |
| Posteriorly; hollow of sacrum; coccyx; pyriformis muscle. |  |                                      |

Having completed the examination the finger is examined for blood, mucus, or pus.

Any of the following five positions may be employed: (1) the knee-chest (or knee-elbow) (see Fig. 17); (2) the left lateral position (Sim's) (or right lateral position); (3) the

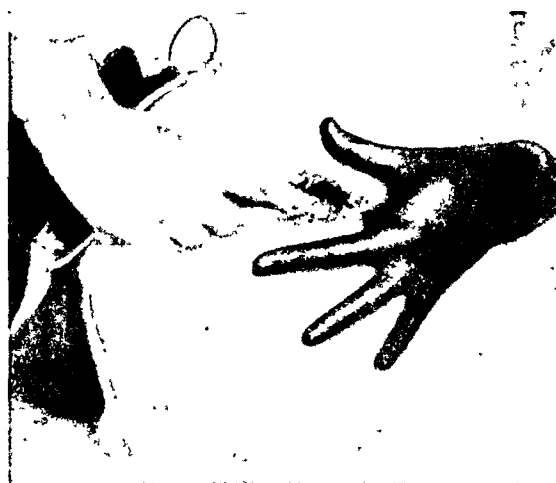


FIG. 17. Rectal examination. Knee-elbow position. (From Bailey.)

lithotomy (or exaggerated lithotomy); (4) the squatting, or (5) the dorsal decubitus. The routine position for the male is usually the knee-chest; for the female, the Sim's position; the squatting posture is reserved for instances in which a high obstruction or tumor is sought or a prolapse is being examined; the dorsal decubitus is reserved for patients who are confined to bed and are too ill to be turned upon the side, particularly those with acute peritonitis.

A rectal examination is indicated in every case of suspected intra-abdominal malignancy. Tumor cells or small masses of neoplastic tissue may become detached from any subserous malignancy and may be thrown into the peritoneal cavity, there to be carried by gravitation to the pelvic peritoneum and to form metastatic growths which may be felt upon rectal digital examination (see Fig. 18).

The sigmoidoscope makes it possible to examine still higher levels of the gastrointestinal tract by way of the pelvic floor. In passing this instrument it is necessary to bear in mind the curves which will be encountered before the abdomen

Transcelomic  
Malignant Trans-  
plants

Passing the Sig-  
moidoscope

is reached. The rectum is not, as its name might imply, a perfectly straight tube. Inspection from the anteroposterior and also from the lateral views shows that it has curvatures

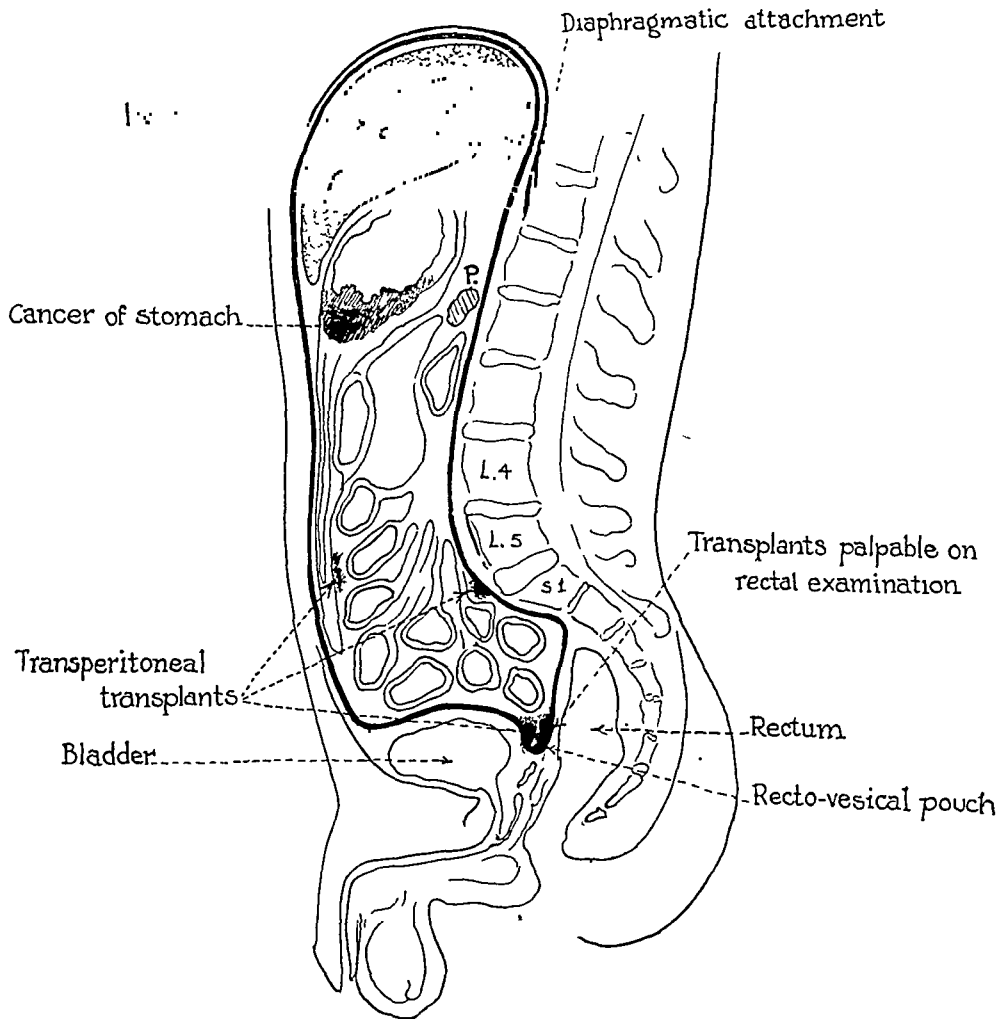


FIG. 18. Transcelomic malignant transplants, showing nodules of malignant tissue which have gravitated to the lowest portions of the peritoneal cavity and may be palpated through the rectal wall.

in both planes. The course of the terminal bowel is as follows: The pelvic colon terminates to the left of the midline; the rectum thence follows the hollow of the sacrum, while the anal canal pierces the pelvic floor in a direction which is downward and *backward*. Therefore the course of the sigmoido-

scope, which passes in the opposite direction, or from below upward, must be: first upward and *forward* through the anal canal ( $1\frac{1}{2}$  in.), then upward and *backward* following the

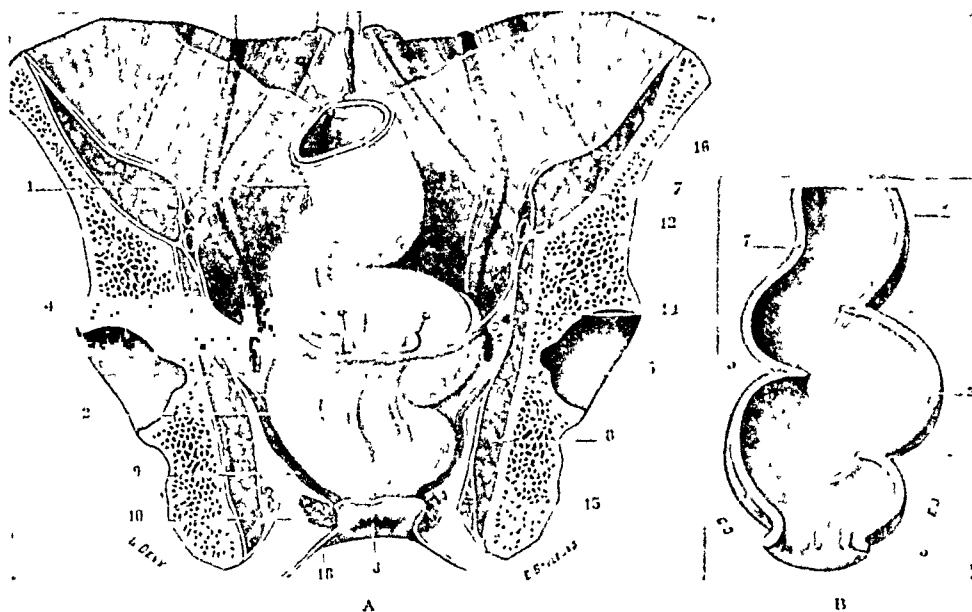


FIG. 19. Houston's valves.

A, Lateral curvatures in rectal walls. Note that middle curve marks approximately level of lowest reflection of the peritoneum.

B, Note sacculations caused by the plicae transversals or semilunar folds of Houston.

depths of the sacral curvature; and finally, in order to clear the sacral promontory and enter the sigmoid colon (i.e. to enter the abdomen), the instrument must be so directed as to take a path which is upward, *forward*, and *to the left*. To facilitate the passage of the sigmoidoscope direct vision through the visual obturator may be employed, and the rectum inflated. The female proves more troublesome than the male as a subject for sigmoidoscopic examination, due to a greater depth of the sacrum in the former. Care must be taken to avoid mistaking for pathological conditions any of the three (the usual number) crescentic shelf-like folds which project into the rectum<sup>20</sup> (plicae transversales recti, or semilunar valves of Houston). Of these folds the largest is situated

upon the right side of the rectum and may serve as a rough landmark for the site of reflexion of peritoneum ( $2\frac{1}{2}$  to  $3\frac{1}{2}$  in. above anus). (See Fig. 19.) The upper and lower folds are on the left side and located from 1 to  $1\frac{1}{2}$  in. above and below the middle fold, respectively. The upper fold marks the rectocolonic junction.

Other instruments used for examinations through the pelvic floor are the cystoscopic and vaginal speculum. There are obvious rewards for the surgeon who acquires skill in the use of the cystoscope and in the interpretation of cystoscopic findings. It is accepted as a rule that any female with abdominal symptoms should be examined vaginally. Bimanual palpation, both recto-abdominal and vagino-abdominal, may prove of special value to the abdominal surgeon, since the external hand frequently can direct a tumor mass against the internal hand, or otherwise so increase intra-abdominal pressure as to greatly facilitate the examination.

Not only may the surgeon introduce objects into the orifices of the pelvic floor, but so also may the patient. Rectal foreign bodies, once they have passed the internal sphincter, tend to travel upward through the descending colon and may even be carried as far as the cecum. The explanation of this fact is found in the reverse peristalsis or anastalsis observed in the large bowel. This intestinal current, which is normal in no other part of the gastrointestinal tract, serves the purpose of keeping the contents of the large bowel from too prompt evacuation and insures a more complete removal of liquid and nutrient elements, with the formation of the semisolid mass constituting the normal stool. Foreign bodies which have been carried upward may become so lodged or incarcerated that they cannot be removed by the aid of enemas, irrigations or purgatives, and hence necessitate abdominal operations for their recovery.

The pelvic floor is no less interesting to the abdominal surgeon as a portal of exit than as a portal of entry. Blood, mucus and parasites discharged with the feces are indicative

Bimanual or  
Pelvi-abdominal  
Palpation

Rectal Foreign  
Bodies

Alvine Dis-  
orders and Abdominal  
Disorders



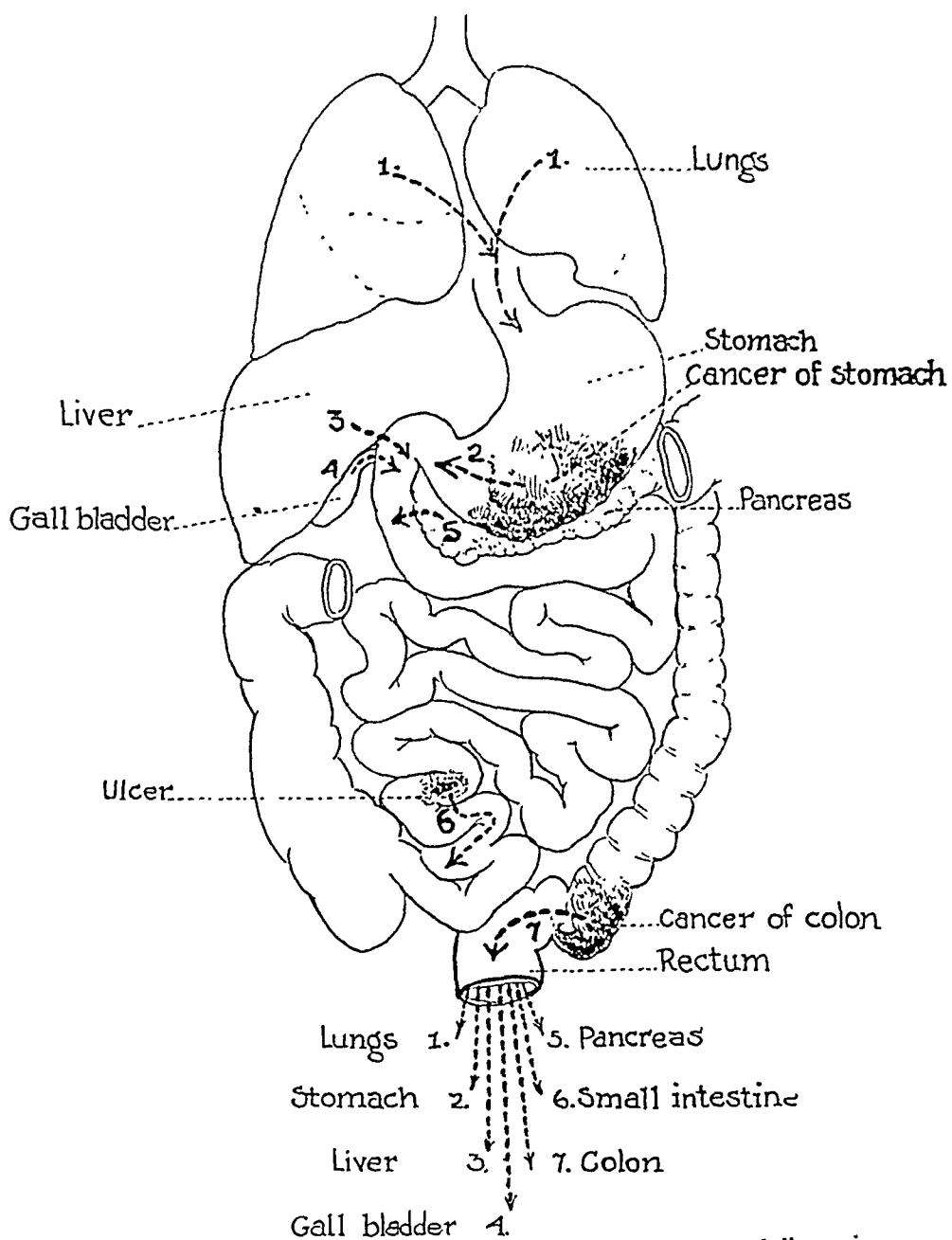


FIG. 20. Value of discharges through the anus in abdominal diagnosis.

of some ulcerative or other pathological process in the intestinal tract. Equally important, the presence of an abnormal alvine (*L. alvus*, belly) discharge may prove an unmistakable guide to some disorder of an organ which is an outgrowth of the primitive enteral canal. Thus biliary disease is indicated by the passage of gallstones or clay-colored and frothy stools, while the presence of steatorrhea (excess of fat) and azotorrhea (excess of nitrogenous materials) suggest pancreatic disfunction (see Fig. 20). Likewise the lung and upper respiratory tract retain a communication with the intestinal canal and may contribute materials to its contents which can be recovered through the anus. Tubercle bacilli swallowed with mucus from the bronchial tube may pass through the enteral tract or may set up a secondary tuberculous enteritis. Germs from an acute infection of the lymphoid tissue of the tonsils may be discharged with the intestinal content or may even initiate such a pathological change as an involvement of Peyer's patches (see Henoch's purpura) or of the lymphoid tissue of the vermiform appendix. Such direct routes of extension are secondary in importance only to the hematogenous pathway.

With severe degrees of prolapse or procidentia of the rectum (*L. procidere*, to fall down or forward), the peritoneal pouches of the pelvis may be actually carried outside of the pelvic floor. Thus in resecting a protruding and redundant mass, the peritoneal cavity may inadvertently be entered, an accident which makes a complicating putrefactive infection and peritonitis exceedingly likely. Again, the herniated pouch may contain prolapsed small bowel. In such a case careless operative interference may be attended by even greater damage. A complete rectal herniation, also known as an archocoele (*G., archos*, fundament + *kele*, tumor,) must be treated by abdominal exposure or rectopexy (*G. pexis*, fixation) rather than by perineal excision. With all rectal prolapses beyond those of the second degree the possibility must be borne in mind that abdominal contents may constitute a part of the external mass (see Fig. 21).

Pelvic Herniation  
of the Peritoneum

### The Open and the Closed Cavity

In interpreting the influence of sex upon the incidence of abdominal diseases the anatomical fact should be kept in mind that in the female there is a direct communication be-

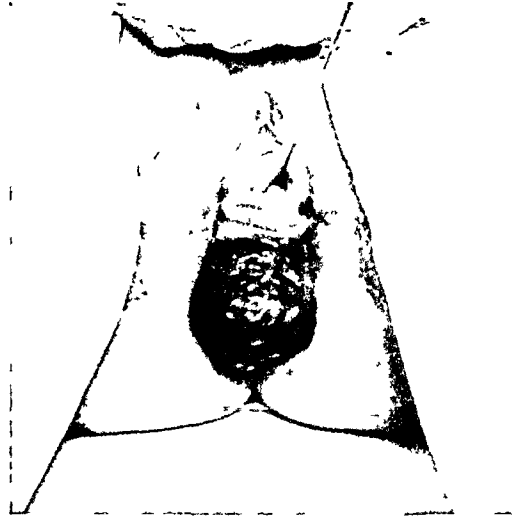


FIG. 21. Rectal prolapse with intestines herniated into pararectal pouch; associated with prolapsus uteri and rectocele from lacerated perineum. (From Keen's Surgery, W. B. Saunders Co.)

tween the peritoneal cavity and the outside of the abdomen by way of the uterus and Fallopian tubes. Normally a mucous plug at the uterine cervix, the tightly contracted cervical sphincters, and the overlapping fimbriae at the peripheral end of the tubes serve to effectively seal the female peritoneal cavity.

### Further Considerations Regarding the Pelvic Floor

Additional important considerations concerning the pelvic floor appear in other chapters. During the study of the abdominal circulation the clinical significance of chronic passive congestion (see Fig. 22) thrombosis and embolism within the rectal and pelvic regions is discussed; in the section dealing with the enteral tract the value of the rectal route for the administration of medications and fluids is considered; in the review of visceral neurology the relationship between pruritus ani and intra-abdominal pathological conditions receives

attention, and the significance for the differentiation between pelvic and abdominal disorders of rigidity of the levatores ani is investigated (muscles innervated on their pelvic surface

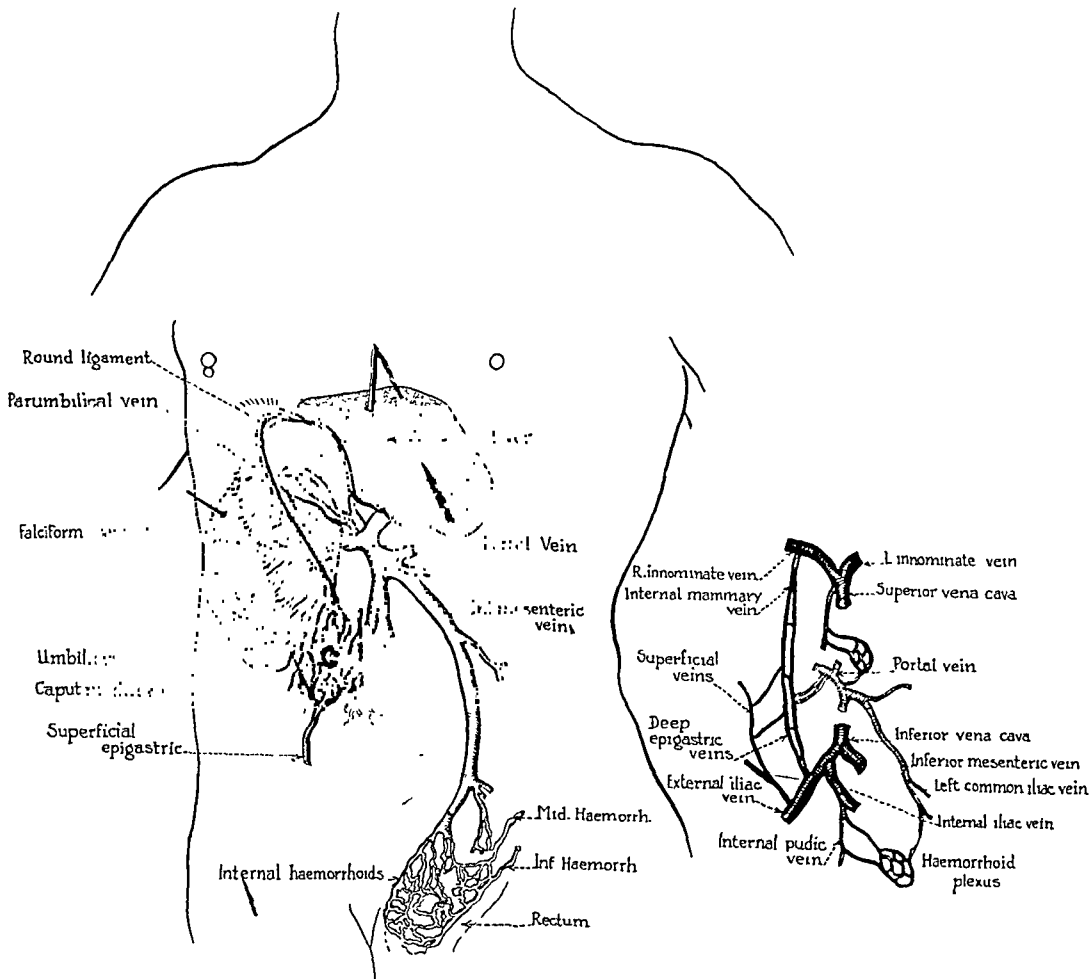


FIG. 22. Hemorrhoids and caput medusae as caused by obstruction to the portal circulation.

by the anterior rami of the third and fourth sacral nerves and on their perineal surface by the perineal branch of the pudendal nerves); in the study of peritoneal drainage, anterior colpotomy is described (see Fig. 23). In like manner, other details concerning the pelvic floor are reserved for pages which follow.

## C. THE ABDOMINAL WALLS

The Thoracic Box  
vs. the Abdominal  
Bag

There exists a striking contrast as to composition between the walls of the upper and the lower divisions of the trunk.

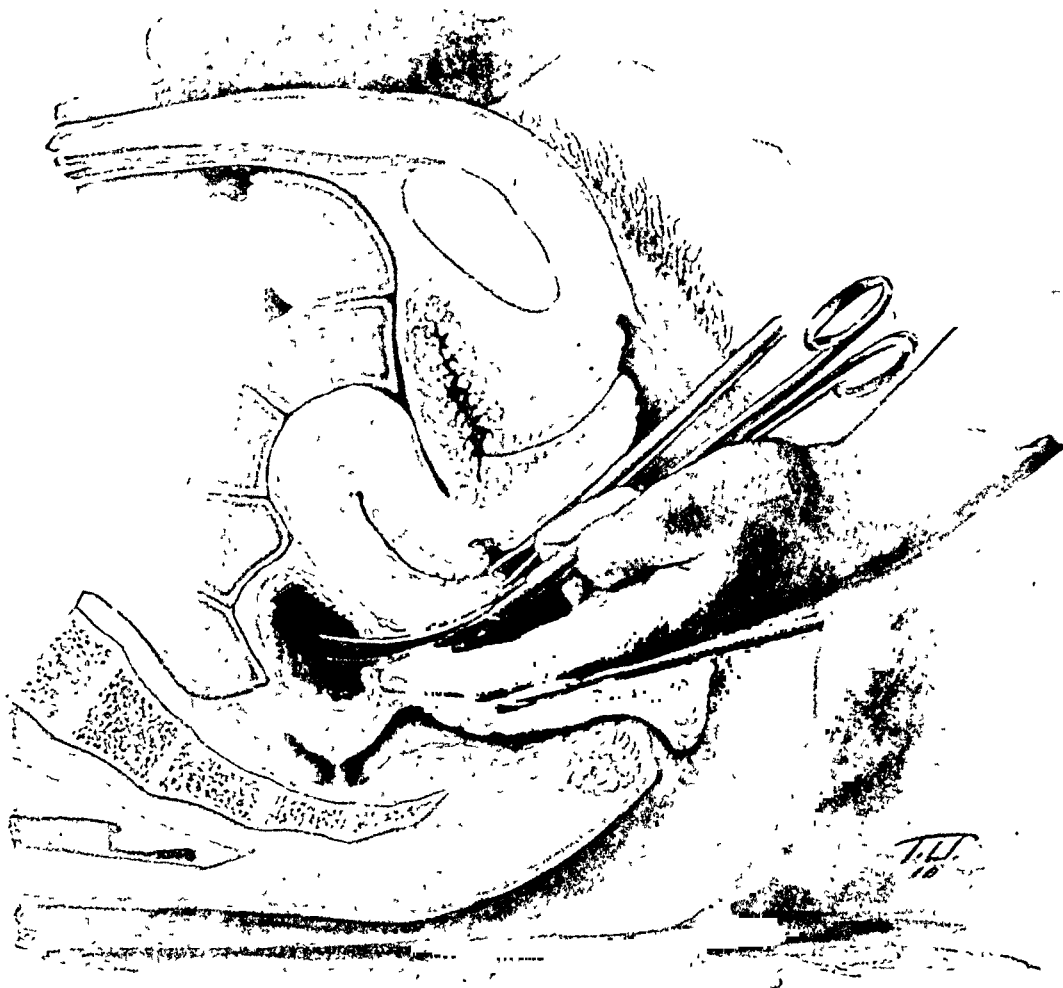


FIG. 23. Anterior colpotomy for drainage of pus which has gravitated to lowest portion of peritoneal cavity. Penetrating abscess wall. The sharp-pointed scissors, under the guidance of the finger, have been introduced into the mass and then opened widely. (From Crossen's Operative Gynecology, C. V. Mosby Co.)

Thoracic walls are composed largely of bone, while abdominal walls are made up chiefly of muscles. The walls of the thorax are rigid; those of the abdomen are soft. This distinction is

implied in the names which have been given to these respective divisions of the body. The word chest means a box (A. S. *cest*, box) and the term thorax, a plate of armor (Gr. *thorax*, a cuirasse). The word belly, on the other hand, signifies a bag (L. *bulga*, bag) or something capable of being alternately filled and emptied. The abdomen is synonymously known as the venter (L. *venter*, belly), just as a chamber of the heart, alternating with the rhythmic cardiac cycle between a contracted and a relaxed state, is termed a ventricle; and as the stomach, periodically changed in size with the intake and output of food, is known as a ventriculus (i.e., a little, or small model belly). Functional activities within the abdominal cavity, as within the thoracic cavity, depend quite largely upon peculiarities in the composition and structure of its walls.

1. *The Muscular Walls.* When speaking of "abdominal muscles" the surgeon often refers simply to the large, flat muscles of the anterior abdominal wall. This is true because patients are usually examined as they lie in the dorsal decubitus, making the anterior wall the presenting surface. This group, however (recti, transversi, external and internal obliques) far from constitutes a complete list of abdominal muscles and it fails to suggest the conception that the abdomen is a muscular bag. The muscles of the posterior wall together with those of the floor and roof, functionally speaking, are coordinated in their action with those of the anterior wall, making possible wide changes in the capacities and pressures within the venter, or belly. The quadratus lumborum, psoas major and minor, iliacus, levator ani, and coccygeus muscles are as deserving of consideration as are the diaphragm and the transverse, straight, and oblique muscles of the front and sides of the abdomen (see Fig. 25). But in addition, the surgeon must know many anatomical details concerning any and all of the muscles which he may sever when entering the abdominal cavity. Thus numerous muscles which support or move the extremities overlie portions of the abdomen, for example the latissimus dorsi and the glutei, and these must be dealt

Muscles Encoun-  
tered in Entering  
the Peritoneal  
Cavity

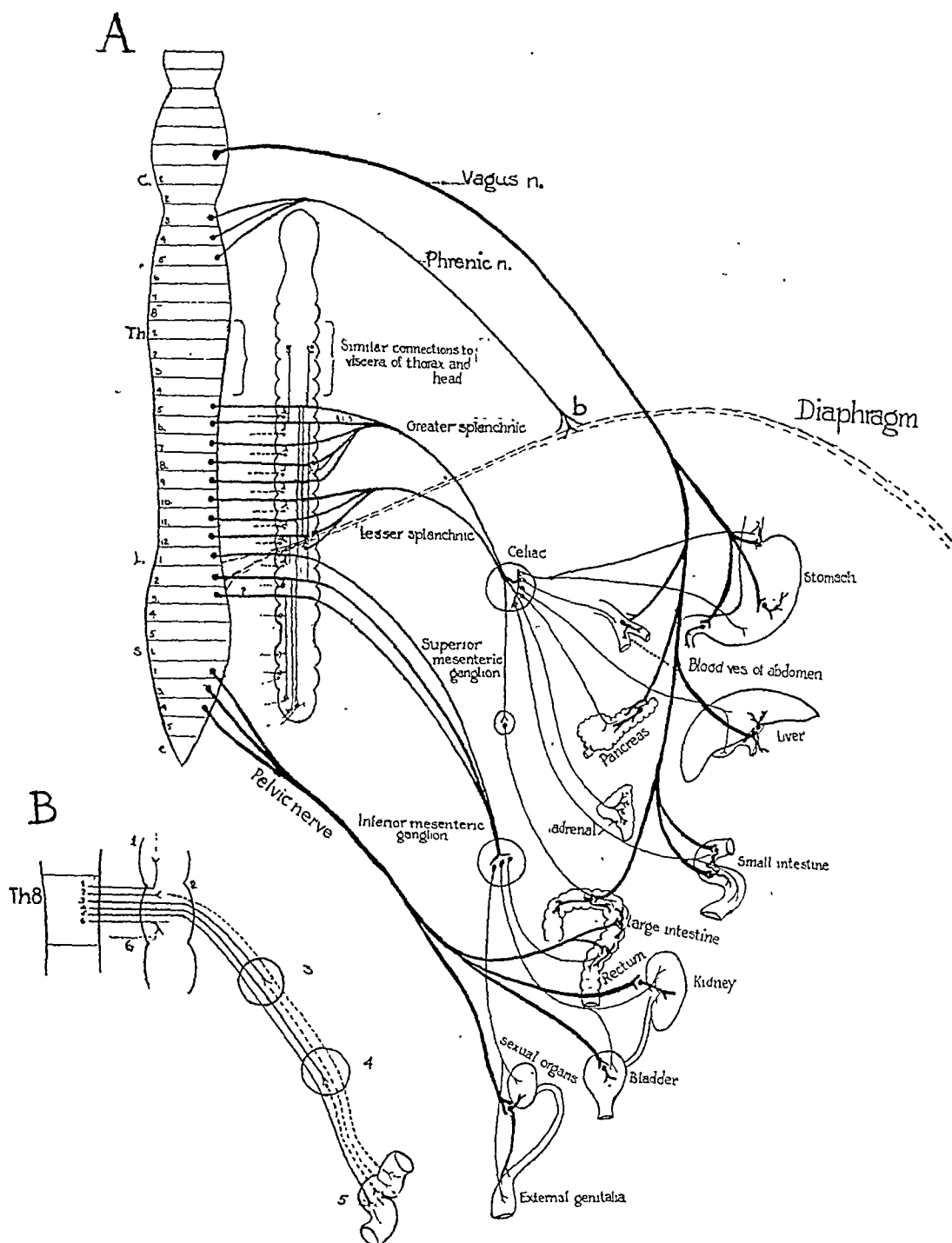


FIG. 24. Nerve pathways between abdominal viscera and spinal cord. B. White rami communicantes.

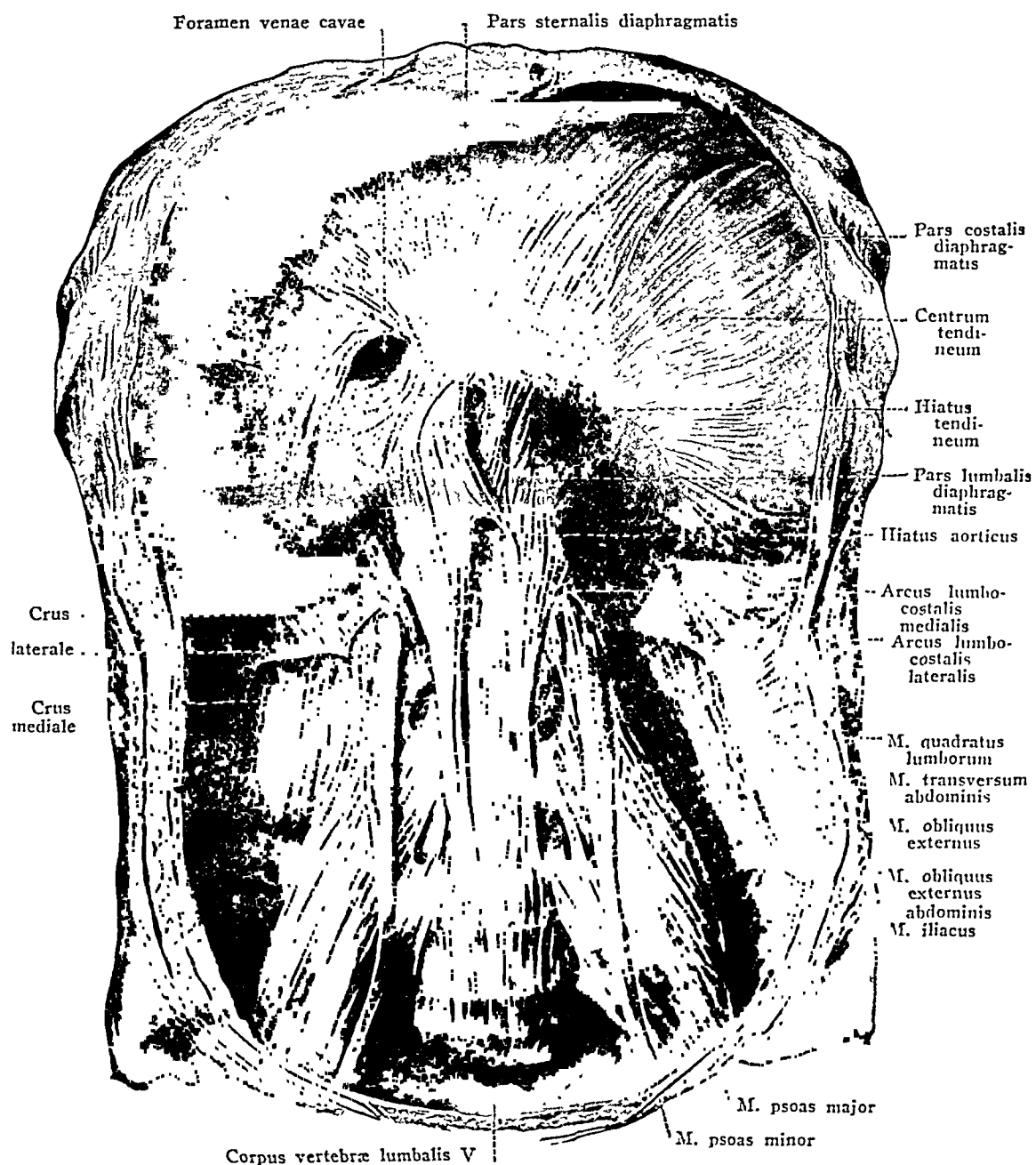


FIG. 25. Muscles of posterior and lateral abdominal walls. (Spalteholz.)



with when operations are performed in special regions, as must also the intercostals and certain other muscles of the thorax when the peritoneal cavity is approached from above.

**Muscles Involved  
by Reflex Spas-  
ticity**

When the abdominal walls are studied for a review of operative surgery, anatomical considerations are of chief importance, but when the abdominal muscles are reviewed for the purpose of gaining some clinical understanding of the reflex spasticities which may accompany disorders within abdominal organs, the major emphasis must be placed upon the innervation, central connections and function of the muscles rather than upon their positions. The reflex mechanisms by which tension variations of the contractile tissues are produced, prove complicated. Abdominal organs are connected with the spinal cord through the white rami communicantes of the sympathetic nerves<sup>21,22</sup> (the thoracolumbar division of the involuntary nervous system; see Visceral Neurology) and these white rami pass to the spinal cord, exclusively between the fifth thoracic and the second (or third) lumbar cord levels (Th<sub>5</sub>-L<sub>2</sub>)<sup>23</sup> (see Fig. 24). Skeletal muscles which exhibit clinical evidence of reflex spasticity from diseases within intra-abdominal viscera are those having motor neurones which are situated in the anterior horns of these particular cord levels (Th<sub>5</sub>-L<sub>2</sub>).

**Connecting Path-  
ways Between  
Abdominal Viscera  
and Skeletal  
Muscles**

That the study of gross anatomy alone is inadequate, in this connection, is shown by the fact that some of the muscles possessing such reflex associations with intra-abdominal structures are situated at a considerable distance from the abdominal cavity itself (examples: rigidity of the muscles innervated through the third and fourth cervical segments, due to irritation of the central portion of the diaphragm, the afferent stimuli traveling by way of the phrenic nerves; spasm of the cremaster muscle with ureteral colic, the reflex being produced through afferent stimuli passing over the white rami communicantes to reach motor neurones of the first lumbar level of the spinal cord). On the other hand, some of the muscles which overlie the abdomen, and thus anatomically form part of its covering walls, possess no such reflex associations with abdomi-

nal viscera. For example, the latissimus dorsi overlies the abdominal cavity posteriorly, arising from as far downward as the crest of the ilium. But this muscle, being innervated exclusively by cervical nerves (C6-C8), has no direct nerve pathways which connect it with the organs of the abdomen. Similarly, the glutei muscles, maximus, medius and minimus, lie in part above the level of the pelvic inlet (hence overlie the lower part of the abdominal cavity), but since these muscles are innervated solely through levels between the fourth lumbar and the second sacral segments of the cord (L4-S2), they could have no direct reflex connection with abdominal organs by way of the white rami communicantes. All muscles with the function of moving any part of the upper extremity derive their motor neurones from the fifth cervical to the second thoracic cord levels (C5-Th2) and the muscles related in an analogous fashion to the thigh, leg, and foot are innervated from the second lumbar to the third sacral cord level (L2-S3). Almost all of these muscles, then, possess no direct reflex pathways associating them with abdominal organs and for the present study of the muscular walls of the abdomen the cavity will be considered simply as a part of the ovoid mass which constitutes the trunk (see Fig. 1), a mass "devoid of extremities, or parts designed to support or move these extremities." (For details concerning the relationship between the muscles of the extremities and intra-abdominal disorders see section dealing with Visceral Neurology.)

The Muscles of  
the Extremities

Studied with reference to morphology and to central connections, then, the list of skeletal muscles of the body wall which may show reflex spasticities from intra-abdominal disorders is as follows<sup>24</sup> (see Fig. 26):

Anteriorly

1. M. rectus abdominis
2. M. diaphragma (sternocostal portions)
3. \* M. pyramidalis abdominis

Laterally

A. Abdominal Group

1. M. obliquus externus abdominis

2. M. obliquus internus abdominis
3. M. cremaster
4. M. transversus abdominis

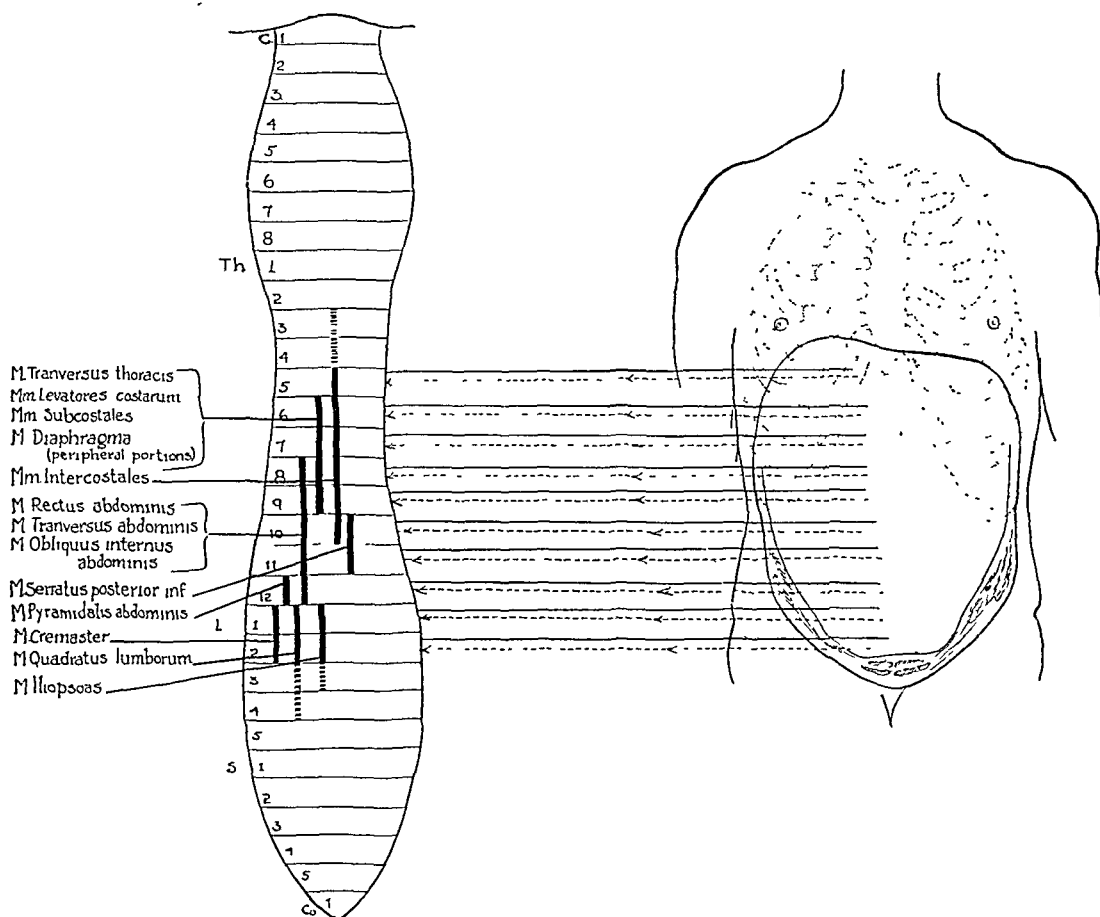


FIG. 26. Innervation of skeletal muscles which show reflex spasticities from intra-abdominal disorders.

#### B. Thoracic Group

1. MM. intercostales externi
2. MM. intercostales interni
3. M. transversus thoracis
4. \* MM. levatores costarum
5. \* MM. subcostales

#### Posteriorly

1. M. quadratus lumborum
2. M. diaphragma (crura)
3. \* M. serratus posterior inferior
4. M. iliopsoas (psoas major, psoas minor, (iliacus)
5. \* M. sacrospinalis (O. T. erector spinae), and other smaller "muscles of back."

\* Signifies muscles of relatively less clinical importance.

The cremasters are included because they arise from the lower portions of the internal oblique muscles. The psoas major and minor are included because they are the only muscles passing to the thigh which attach the lower extremity to the trunk and pelvic girdle; i.e. they move not only the lower extremity but the trunk as well. The peripheral portions of the diaphragm are included because they are innervated through the lower thoracic nerves in contrast to the central portion which is innervated through the phrenic nerves (C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub>).

Little comment need be given to reflex rigidities of the recti, transversi and external and internal obliques, for these are generally and well appreciated. But certain equally constant analogous rigidities are not so commonly recognized. It would seem unreasonable to believe that any of these muscles, possessing as they do motor nerves and central connections, should fail under certain conditions to be thrown into reflex spasticity, even though this spasticity be imperfectly understood, difficult to detect, or appear to be of relatively less clinical value. Spasticities of the intercostal muscles and diaphragm from abdominal disorders are, perhaps, not generally appreciated, but account for the dyspnea which often accompanies such upper abdominal conditions as acute cholelithiasis and cholecystitis. Reflex spasms of the quadratus lumborum, psoas, and cremaster muscles are as important in many renal and ureteral disorders as are rigidities of the anterior muscles from acute diseases of the appendix or gall bladder. No clinical tests have been described in regard to spasticities of the pyramidalis, serratus posterior inferior, the transversus thoracis; and probably, from the small size and the anatomical positions of these latter muscles, they are of relatively less clinical value, yet their central connections demand that they be included in the present list.

Abdominal Rigidities; Reflex; Spasticities

The accompanying chart tabulates, for convenience, many of the following points with which the abdominal surgeon should be familiar concerning each muscle: its origin, insertion, function, meaning of name, innervation by peripheral nerves,

relationship to spinal segmentation and to the involuntary nervous system; also the position or body posture caused by its continued contraction, and points of special clinical significance.

After a brief discussion as to methods for detecting reflex muscular rigidities, clinical points will be reviewed concerning the muscles which have been tabulated with reference to the diagnosis of intra-abdominal diseases.

The Examination  
for Rigidity

While spasm of a muscle may produce a characteristic alteration in position or a typical posture which is readily detected by inspection alone, chief reliance for the discovery of muscular rigidity must be placed upon palpation. Abdominal palpation is performed with the flexor surfaces of the fingers and hand, laid almost flat upon the belly walls. A slow, steady pressure, combined with slight flexion of the fingers, gives the examiner a means for estimating the resistance present. To poke at the abdomen with the fingertips alone produces a voluntary muscle spasm. Spasm is also induced by examining hands which are cold. The hands may be warmed by dipping them in tepid water, by holding them for a few moments within the axillae, by rubbing them briskly together; or the examination may be commenced with a layer of cloth (gown, sheet, towel) between the examiners hands and the skin of the patient. The patient lies in a relaxed position, arms at the side, head flat, thighs and legs resting upon the bed, or the thighs are slightly flexed over a bolster or pillow (attempts to have the patient keep his own thighs flexed without support may result in more rather than less abdominal tension); the patient is instructed to breathe deeply and quietly through the mouth; talking, on the part of the patient, is discouraged, but the examiner both by his tone and manner attempts to quiet the patient and to divert attention from the examination. The mind of the examiner, on the other hand, keeps pace with the examining hand and an attempt is made to visualize intra-abdominal structures. If the patient has complained of symptoms in a certain region of the abdomen, palpation

commences at a distance from this point and the area supposedly involved is secondarily approached.

To detect slight degrees of involuntary spasm requires

Comparative  
Bimanual Abdomi-  
nal Palpation



FIG. 27. Method of bimanual comparative abdominal palpation. Note how fingers of left hand sink deeply into abdominal wall while those of right hand undergo a lessened descent, due to rigidity of right lower quadrant (appendicitis). Exactly equal pressure must be exerted by the two hands.

great care and as a rule clinical experience. A valuable method suggested by Murphy is known as "bimanual comparative abdominal palpation."<sup>25</sup> Here, in place of examining first one region, then another, by means of a single hand, the examiner places his two hands in analogous positions upon the belly wall (example, the two lower quadrants) and by increasing pressures slowly and equally with the two hands, observes whether one hand sinks more deeply into the abdominal wall than the other (see Fig. 27). "Compare the manner in which the examiner's left hand sinks into the patient's left iliac fossa to the lessened descent of the right hand on the side

of the slightly inflamed appendix." Differences in abdominal tension which might otherwise easily be overlooked may be detected and objectively demonstrated by the use, after practice, of this method of comparative palpation.

**Palpation through  
the Indrawn Wall**

Abdominal palpation proves particularly unsatisfactory when the patient is muscular or is apprehensive regarding the examination. Voluntary rigidity prevents the examining fingers from reaching a sufficient depth satisfactorily to search for tumors and misplaced or enlarged organs. The following technical "dodge" may be employed to put the overactive abdominal muscles to direct use and to remove apprehension, changing the patient's mental attitude from one of guarded resistance to one of cooperation. Carry the examining fingers to whatever depth they will readily sink with slow steady pressure; then ask the patient to "draw the abdominal muscles inward," that is, to make his abdomen "as thin as possible;" now ask the patient to relax completely and to breathe with the mouth wide open. It will be found that as the abdominal muscles are drawn inward the examining fingers sink to a surprisingly greater depth and as the patient relaxes, the abdomen may be palpated at the new level with relative ease and satisfaction (see Fig. 28). This method of examination might be designated "palpation through the indrawn wall."<sup>24</sup>

**Palpating with a  
Depressed Costal  
Arch**

Another aid to palpation consists of making inward pressure upon the lower ribs anteriorly, thereby shortening the distance between the points of origin and insertion of the anterior abdominal muscles of that side, adding to their relaxation. The technic for the procedure is as follows:<sup>24</sup> Place the "heel" of the dorsiflexed hand (i.e. the thenar and hypothenar eminences) over the hypochondrium upon the side to be palpated (i.e. over the lower portion of the anterolateral surface of the thoracic cage); make steady pressure upon the ribs until they sink definitely backward; with the opposite hand palpate the subcostal area and upper quadrant of this side of the abdominal wall. It will be found that as the cage

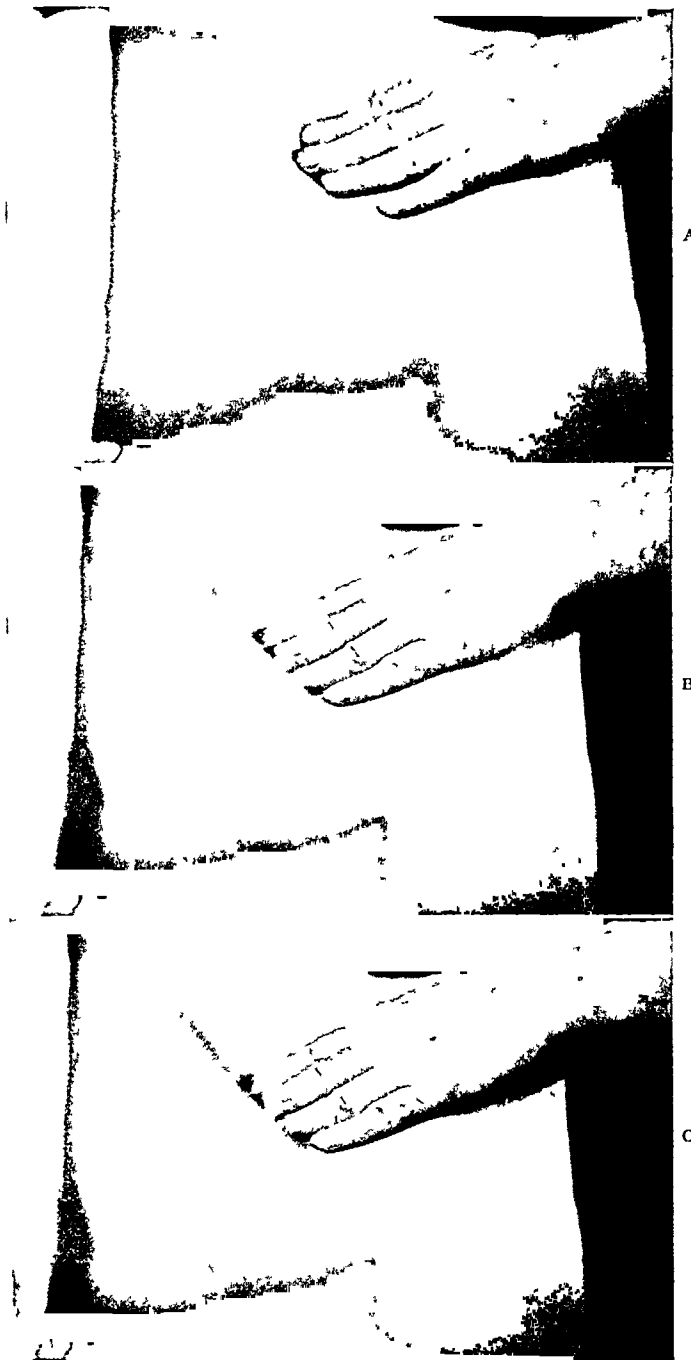


FIG. 28. Abdominal palpation with indrawn wall.

- a. Voluntary rigidity prevents the examining fingers from sinking into the abdominal wall.
- b. Examining fingers sink deeply into abdominal wall as the patient draws his anterior wall sharply inward.
- c. As the patient then relaxes the examining fingers remain deep within the wall, facilitating the examination.



is pressed inward, the fingers of the examining hand sink to a lower level, enhancing the ease of abdominal examination. This method might be designated "palpating the abdomen



FIG. 29. Abdominal palpation with depressed costal arch.

- A. Voluntary rigidity renders the examination unsatisfactory.
- B. As the costal arch is pressed inward the muscles of the anterior abdominal wall are relaxed, facilitating the examination.

with a depressed costal arch" (see Fig. 29). Abdominal palpation conducted with the aid of both the indrawn wall

and the depressed costal arch increases to a maximum the total area of abdomen which comes within reach of the examining fingers.

Respiratory difficulties may readily be demonstrated clinically as an accompaniment of acute abdominal disorders as well as of thoracic diseases. In numerous isolated accounts a reflex spasticity of the muscles of inspiration observed with pathological changes within the abdomen has been convincingly described. Postoperative respiratory changes were discussed over a quarter century ago (Czerny<sup>26</sup>) and suggested as one possible cause for the development of postoperative pneumonia. Diaphragmatic spasticity has been reported as occurring with perforated and perforating gastric ulcers (Hubeny,<sup>27</sup> 1916; Hughes<sup>28</sup> 1917). Reflex spasticity of the diaphragm, confirmed by auscultation and roentgen-ray examinations, was demonstrated by Sale<sup>29</sup> (1918) in 19 cases of acute appendicitis (Sale's phenomenon). Dyspnea from acute pancreatitis has been frequently observed (Pottenger,<sup>30</sup> Cope<sup>31</sup>). Dyspnea has been stated to be present in 71 per cent of cases of acute cholelithiasis (Bodenstab,<sup>32</sup> 1918, in a study of the symptoms in 500 cases of gall-bladder disease). That these convincing observations have not gained general recognition, however, is apparent in the fact that textbooks dealing with acute abdominal disorders rarely make mention of such reflex dyspnea as a symptom. Even those current reference books written for the express purpose of listing the various possible causes of individual signs and symptoms, discuss over a hundred conditions giving rise to the several types of dyspnea without giving any indication that this symptom (dyspnea) might arise as a reflex from acute diseases of abdominal organs such as the stomach, gall bladder, pancreas, or appendix. All too frequently no history is sought of "inability to take a full breath" or "catches in breathing" when interviewing patients with suspected cholelithiasis or cholecystitis.

Reflex spasticity of the respiratory muscles arising from abdominal disorders, is produced through the lower intercostals

Reflex Dyspnea  
from Abdominal  
Disorders

Dyspnea with  
Cholelithiasis

Inspiratory  
Dyspnea

(muscles innervated from the 5th to the 12th thoracic levels of the cord), through the peripheral portions of the diaphragm (innervated by the lower intercostal nerves), and through the serratus posterior inferior, (10th and 11th thoracic levels, posterior rami) and other lesser muscles of respiration, levatores costarum, subcostales and the transversus thoracis which receive innervation through the anterior rami of the lower intercostal nerves. The dyspnea takes the form of difficulty with the inspiratory phase of the respiratory cycle, particularly upon attempts at forced inspiration.

Methods for  
Detecting Spas-  
ticity of the  
Diaphragm

Since the diaphragm cannot be directly palpated, diminished action of this muscle upon a single side may be detected by the following methods. (a) By auscultation. Here there is found a quantitative difference between the involved and non-involved sides as to the loudness, length, and intensity of the inspiratory murmur (feebleness upon the right side with cholecystitis). (b) By roentgen-ray examination. Sales states that "the Roentgen ray in every case substantiated the stethoscopic findings;" with acute appendicitis the right dome was found to be flatter than the left and showed a diminished excursion (normally if any difference between the two domes can be detected it is the right side which is more dome-shaped and has the wider excursion). (c) By direct observation of the diaphragmatic phenomenon, using the same methods as utilized when searching for Litten's sign (see section on eponyms); (the diaphragmatic phenomenon is retarded and the excursion lessened upon the involved side). (d) By percussion, i.e. percussing the lower thorax posteriorly first during quiet breathing, then during forced inspiration, and measuring the difference in level of the dullness present, thus obtaining the estimate of the excursion of the diaphragm upon that side (comparison of the two sides shows a diminished excursion upon the side involved).

Differentiation  
between Thoracic  
and Abdominal  
Disorders

This involvement of certain of the muscles of respiration by both abdominal and thoracic disorders adds to the difficulties of differential diagnosis. It should be recalled, however,

that when the afferent or sensory stimuli arise from above the diaphragm (thoracic diseases) additional muscles of respiration are usually involved (levels above the 5th thoracic) and reflex spasticities in the upper thorax and in the muscles attached to the shoulder girdle are added to the clinical picture (see trapezius test in differentiating between basilar pleurisy and acute appendicitis etc.; (Visceral Neurology). Here the dyspnea tends to be relatively more acute and to affect both phases of the respiratory cycle, while abdominal rigidity, if also present, tends to be greatest immediately below the costal arches. When the afferent or sensory stimuli arise from below the diaphragm, upon the other hand (abdominal disorders), the dyspnea is relatively less in degree, is inspiratory in character, and is not associated with spasticities or tenderness in the muscles of the upper portions of the thorax or those directly concerned with movements of the upper extremity. With abdominal diseases yielding the dyspnea, there is also present a marked rigidity of the abdominal muscles and this is greatest, not immediately below the costal arches, but over the region well known to be reflexly associated with the abdominal organ involved. In the presence of dyspnea of the spastic type, then, an estimate should always be attempted as to which is the greater: the thoracic rigidity (as evidenced by diminished expansion) or the abdominal rigidity (as detected by palpation), and the full extent of the involvement of thoracic muscles should be determined. The data gathered from physical examination, as in any differential diagnosis, must be most carefully correlated with a complete and detailed history. Clinical errors in which a needed abdominal operation is delayed under the impression that the disease present is thoracic are relatively uncommon. Blunders in which a needless abdominal operation is performed when the disease is actually present within the chest (pleurisy, pneumonia, mediastinal hemorrhage mistaken for acute appendicitis) occur with relative frequency. It must be recalled (see Section I, the abdominal roof) that all of the nerves passing to upper abdominal viscera must traverse the

Correlation of  
Physical Findings  
with History

thoracic cage before reaching their destination, hence they are exposed to direct irritation from thoracic disorders.

Spasticity of the cremaster muscles gives rise to accentua-

### Cremaster Spasm and the Subinguinal Syndrome

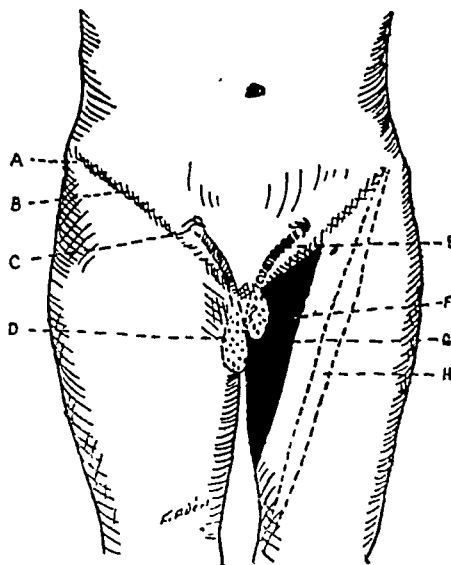


FIG. 30. Subinguinal syndrome of renal colic. Triangular cutaneous area of clinical value in determining presence of intra-ureteral tension.

A, crest of ilium. B, anterior superior spine. C, abdominal ring. D, normal position of testis E, Spermatic cord and cremaster muscle. F, Elevated testis. G, Skin zone. H. Sartorius muscle.

tion of the cremasteric reflexes, to corrugation of the scrotal skin, and to retraction of the testicle. It would be difficult to overestimate the value of cremaster spasm in the differentiation of renal colic from acute intra-abdominal conditions such as acute appendicitis and acute cholelithiasis. Given a patient with severe colic, the detection by simple inspection of cremaster spasm clearly indicates the correct diagnosis, for this sign constitutes presumptive evidence of renal or ureteral colic. Cremaster spasm is usually associated with the other phenomena of the so-called "subinguinal syndrome" of acute ureteral colic<sup>33,34</sup> (i.e. hyperesthesia limited to the ureteral skin triangle of the thigh, altered responses to heat and cold within this area, local vasomotor phenomena, tenderness of the isolateral testicle) (see Fig. 30). (See Visceral Neurology.)

Spasticity of the quadratus lumborum causes the trunk to be flexed laterally toward the involved side (inability to assume an erect posture). Rigidity of this muscle, as that of other muscles of the loin, is caused by renal or ureteral disorders and by diseases of other structures innervated through upper lumbar cord levels, rather than through diseases of upper abdominal organs which have their central connections at thoracic cord levels.

Lateral Flexion of  
the Trunk with  
Renal Colic

Spasticity of the iliopsoas similarly (lumbar innervation) is reflexly produced through lower abdominal, renal or pelvic disorders rather than by upper abdominal conditions. The psoas muscle, however, due to its position immediately beneath the parietal peritoneum, may be directly involved or irritated by inflammations or productive infiltration over the muscle. Continued contraction of the iliopsoas causes a flexion posture of the thigh. Reflex spasticity of lesser degrees may be detected by the so-called psoas test (Treves;<sup>35</sup> Cope<sup>36</sup>) which consists of searching for muscular resistance and pain as the lower extremity is passively hyperextended. In making this examination the patient may lie face downward and the thigh be then lifted upward, or the patient may lie on the side opposite to the one being tested, as the lower extremity is slowly forced backward.

Psoas Test;  
Spastic Flexion of  
the Thigh

To illustrate the manner in which the psoas may be thrown into a state of spasticity by organs which are not directly connected with the muscle by way of the spinal cord and the white rami communicantes but which involve the muscle directly: The patient with an acute appendicitis may have a rigidity of the right lower quadrant and also a flexion posture of the thigh or positive psoas test, both being due to muscle spasm, but the rigidity of the anterior and lateral abdominal muscles represents an early involvement and is a reflex spasticity produced through the involuntary nervous system, while the rigidity of the posterior muscles represents a later and a direct involvement caused by a local irritative process from the overlying inflammation and is produced by way of the cerebrospinal system.

Viscerogenic  
Reflex Spastici-  
ties vs. Peripheral  
Nerve Irritations

All of the spasticities referred to will again be considered in the section dealing with Visceral Neurology and at that point attention will be focused upon the specific neurone pathways and synapses which make possible alterations in the skeletal muscles which may be detected during the clinical examination.

Hoarseness with  
Colics

There are many motor phenomena associated with abdominal disorders other than those which involve the muscles of the abdominal walls *per se*. There may occur (by way of the vagus) a spastic contraction of the laryngeal muscles, giving rise to hoarseness as observed with severe colics (and although Hippocrates spoke of "the muffled voice of colics,"<sup>37</sup> how often still is the patient unjustly maligned for speaking in a whisper); there may occur involvement of the muscles associated with the eye (by way of the cranial autonomies) with a resulting disturbance of vision; the tensor tympani muscle of the inner ear may be reflexly involved (vagus) with a resulting tinnitus aurium; through the nervus erigens there may occur analogous spasticities of smooth muscles in the rectal and perirectal regions. At times the motor responses from intra-abdominal disorders represent viscerovisceral phenomena, where both the afferent and efferent stimuli travel exclusively within the involuntary or vegetative nervous system (example: reflex pylorospasm); at other instances they are of the visceromotor type, where the afferent stimulus travels by way of the involuntary system but the efferent stimulus travels by way of the anterior root fibers of the cerebrospinal system (example, a peripheral abdominal rigidity from an acute inflammation or colic); and in still other cases the muscle spasm is simply the result of a peripheral nerve irritation, having no afferent but merely an efferent pathway (example, spastic adduction of the thigh from pressure upon the obturator nerve as it passes into the pelvis, John Hilton.<sup>38</sup>) In subsequent pages which deal with symptomatology, such motor responses are taken up one by one, in detail, an attempt being made both by charts and words to give as accurate as possible an explanation of the most common of the clinical signs.

Viscerovisceral  
vs. Visceromotor  
Phenomena

It is obvious that the surgeon must thoroughly study *all* of the muscles which form a part of the abdominal walls and that even this is not sufficient since there are instances in which intra-abdominal diseases may cause motor phenomena at every level of the cerebrospinal system, some in the cranial, others in the cervical, and still others in the thoracic, lumbar, or sacral levels (Visceral Neurology).

2. *The Bony Walls.* No portion of the body receives less skeletal support than the abdomen. The only bones which belong exclusively to the abdominal division of the trunk are the five lumbar vertebrae. The abdomen, as already observed, is a muscular bag. Yet while the abdominal cavity receives but little skeletal support it by no means follows that it receives inadequate skeletal protection. Protection is obtained both from the bones of the thoracic cage and from those of the pelvic walls. The abdomen, due to the domed shape of the diaphragm, has been seen to extend well within the thoracic cage which serves to protect all the organs of the supracolic division of the peritoneal cavity. Similarly, the abdomen in its lower aspects (within the protection of the iliac bones) blends with the true pelvis and the separation of abdomen and pelvis is purely arbitrary. A list of the bones which overlie, and therefore in reality form walls for the abdominal cavity are:<sup>39</sup> a variable portion of fifteen of the twenty-four ribs; the five lumbar vertebrae, with their numerous processes and intervertebral discs; the xiphoid process of the sternum (cartilaginous); the iliac bones; the upper border of the sacrum; and portions of the pubes.

Posteriorly and laterally, then, the abdomen is provided with almost complete bony protection. And upon the sides, the lower ribs and their cartilages extend to within one to three finger-breadths of the iliac crests! Upon the lateral wall of the abdominal cavity the purely muscular portion is simply this narrow interosseous space of but 1 to 3 inches in width. At the level of the tip of the eighth costal cartilage (intercostal angle), not over 10 per cent of the circumference

The Skeletal  
Support vs. the  
Skeletal Protec-  
tion of the  
Abdomen

The Limitations  
of Abdominal  
Palpation



TABLE

STUDY OF SKELETAL MUSCLES WHICH SHOW REFLEX SPASTICITY FROM

Muscles	Cord Levels	Peripheral Innervation	Functions
M. rectus abdominis..... M. obliquus externus abdominis.....	Th7-12	Anterior rami of lower six thoracic nerve	Support abdominal organs Aid in act of expiration
M. obliquus internus abdominis..... M. transversus abdominis	Th7-L1	Ant. rami lower six thoracic nerves. Lower portions of muscles likewise by the iliohypogastric nerve (L1)	Aid in acts of vomiting, defecation, micturition, and parturition Flexors of vertebral column and pelvis
M. pyramidalis abdominis.	Th 12	Anterior ramus of last thoracic nerve	Aids rectus abdominis Tenses fascia of ant. wall
M. cremaster.....	L1-2	Genitofemoral nerve	Elevates testicle Corrugates scrotal skin
Diaphragma (peripheral)...	Th7-12	Anterior rami of lower six thoracic nerve	Aids in inspiration "Fixes" lower ribs
M. serratus posterior inferior	Th11-12	Posterior rami of last two thoracic nerves	Fixes twelfth rib Aids diaphragm in inspiration
MM. intercostales externi MM. intercostales interni MM. levatores costarum. MM. subcostales..... M. transversus thoracis..	Th2-10 (Abdominal Reflexes-Th5-10)	Anterior rami of the thoracic nerves	Aid in acts of both inspiration and expiration
M. sacrospinalis (and other "posterior groups")	(Th2-L5) (Th5-L2)	Posterior rami of all Spinal nerves	Extensors, lateral flexors, rotators or vertebral column
M. quadratus lumborum...	L1-4 (L1-2)	Anterior rami of first three lumbar nerves	Lateral flexor of vertebral column. Assists with inspiration
M. iliopsoas .....	L1-4 (L1-2)	Anterior rami first three lumbar nerves	Flexes hip joint, also trunk on extremity. Medial rotation of thigh

I

## ABDOMINAL DISEASES (IMPULSES TRAVELING OVER WHITE RAMI COMMUNICANTES)

Body Posture from Continued Contraction	Associated Clinical Data
Patient lies flat on back Abdomen "splinted" Distance from costal margin to pelvis shortened Costal arch depressed on involved side	Segmental and local rigidities with such acute conditions as appendicitis and cholelithiasis Local muscular tenderness (as above) Board-like abdominal wall (anterior) with acute peritonitis Thoracic breathing Excessive flaccidity and atrophy with chronic peritonitis.
Muscle small and inconstant.....	Marked tension and tenderness immediately above symphysis pubis
Testicle elevated. Scrotum small and wrinkled	Functional muscle change associated with tenderness of isolateral testicle and other changes in "subinguinal syndrome of ureteral colic" Ureteral skin triangle of hyperesthesia
Unilateral diminution of inspiratory phase	Lessened excursion of thoracic cage Diminution of diaphragmatic phenomenon Fluoroscopic flattening of domes Auscultatory and percussion evidence (see text)
Diminution of respiratory movements..	Local tenderness (deep) over muscle
Fixation of chest..... Lessened alteration of both anteroposterior and lateral diameters of thoracic cage	Thoracic respirations diminished Chest movements of involved side lessened "Quiet lung" on involved side Abdominal breathing
Spine held rigid, flexed and rotated to involved side	See function. Local deep segmental tenderness
Body drawn toward involved side....	Deep muscular tenderness between twelfth rib and iliac crest. Patient unable to stand erect
Flexion of thigh, slight internal rotation Tends to flex trunk on lower extremity Slight lateral flexion of trunk	Affected locally by peritonitis on lower posterior wall of cavity. Thigh is flexed on trunk. Trunk slightly flexed to involved side. Psoas test positive (passive extension of thigh and external rotation painful) Walking interfered with

of the abdomen is free of bone. The limitations of abdominal palpation must be apparent.

The bones which are so widely distributed over the ab-

**Bony Landmarks  
of the Abdominal  
Wall**

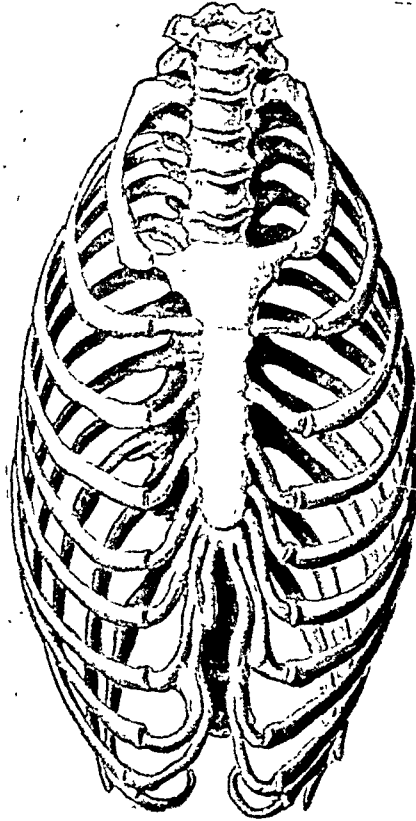


FIG. 31. Skeleton of thoracic cage showing marked deformity characteristic of "habitus enteropticus." Note unusually narrow intercostal angle. (After Schultze.)

domen provide a convenient system of landmarks. Such points are of use in outlining the various viscera, in localizing tumors, in determining the exact sites for the injection of local anesthetics. The landmarks of the spinal column and os coxae are fixed and constant. Those connected with the costal margins are inconstant in position since the thoracic cage is attached only posteriorly and is movable. In the portion of this chapter headed Abdominal Topography, details concerning the clinical use of these bony points are discussed.

It has been said that every abdominal examination should begin with an inspection of the intercostal angle.<sup>40</sup> Differences of the most profound nature exist between patients having narrow and those having wide intercostal angles.<sup>41</sup> These differences concern the intra-abdominal arrangement of the organs, intra-abdominal pressure and pressure variations; also matters pertaining to surgical diagnosis and treatment (see Fig. 31). Under the headings Visceroptosis, and Mesenteric Ileus will be found full discussions regarding the causes and results of variations in the angle formed by the costal margins. A study is made of the relationship between non-rotation of the bowel or partial rotations of the bowel and the secondary bony changes within the thoracic cage; the visceroptotic individual is considered as the victim of a congenital constitutional defect and as one who possesses a fundamental weakness of connective tissue. So important an index as to the type of the individual is the configuration of the intercostal angle that the observation of this bony landmark should, perhaps, be the first step in any abdominal examination.\*

[\* The study of the abdominal walls will continue in the March issue of the Journal.]

## EPONYM

## JAMES MARION SIMS

- Eponym:** Sims' position.  
The left lateral decubitus.
- Name, Nativity:** James Marion Sims. Lancaster District, South Carolina, U. S. A.
- Birth, Death:** Born, January 25, 1813. Died November 13, 1883.
- Connections:** A founder of the State Hospital for Women in 1855 (New York City).  
Made Governor and Senior Consulting Surgeon of Woman's Hospital (New York) in 1868.  
Surgeon-in-Chief of Anglo-American Ambulance Corps in 1870 (Franco-Prussian War).  
Member of Board of Surgeons, Woman's Hospital, 1872.  
President of American Medical Association in 1876.  
President of American Gynaecological Society in 1880.  
Received degree of Bachelor of Arts at the College of South Carolina in 1832.  
Began the study of medicine in the office of Dr. B. C. Jones, a practitioner of Lancaster, S. C.  
Took his first series of lectures in medicine at the Medical College of Charleston, South Carolina (1834).
- Education:** A graduate from Jefferson Medical College, Philadelphia, in 1835.
- Source of Eponym:** From book of author: *Clinical Notes on Uterine Surgery*, published in London in 1866 by Robert Hardwicke (pp. 23-24).
- Other Writings:** His first contribution to surgical literature was his paper on *Trismus Nascentum* appearing in the *American Journal of Medical Sciences* in 1846.  
*Silver Sutures in Surgery* (1849).  
*Vesicovaginal fistula* (1852).  
The Careful Aseptic Invasion of the Peritoneal Cavity for the Arrest of Hemorrhage, the Suture of Intestinal Wounds, and the Cleansing of the Peritoneal Cavity, and for all Intraperitoneal Conditions (1881).  
(See indices for other Papers.)
- Discussion of Eponym:** Sims, while practicing in Alabama, was called to attend a country woman who had sustained an acute displacement of the uterus due to a fall from a horse. While examining his patient digitally by the vaginal route with the patient upon her knees, he was suddenly unable to feel the displaced uterus and the patient was at that moment relieved of her symptoms. Sims was unable to account for this until, as his patient assumed the dorsal decubitus, there was a sudden expulsion of air which gave a ready explanation of the replacement of the uterus. Thereafter Sims employed the knee-chest position as a routine for vaginal examinations and described in his writings how air, with its 14 pounds pressure to the square inch, aided in dilating the vaginal walls; he then devised his special speculum (first a bent spoon) to aid in the admitting of air for the visual examination. Later, after coming to New York, he changed to the routine use of the left lateral posture for pelvic examinations, using the knee-chest posture only for special examinations or treatments.
- Points of Interest:** Sims, "a kind-hearted but impulsive man, was one of the most original and gifted of American surgeons."  
His career as a specialist in New York City was preceded by eighteen years of general practice in Alabama.  
Sims moved to New York as the result of two years of sickness in which he wandered about but was unable to practice (persistent diarrhea which had proved generally fatal to patients remaining in Southern states).  
With a growing family and in straightened circumstances he settled in the outskirts of New York City (1853) at what is now Madison Avenue at 29th Street. There was at that time no first-class dwelling nearer than 23d Street, and the location afforded a full view of the East River. Sims' first patient, who suffered from vesicovaginal fistula, was referred by Dr. Valentine Mott.

## PREFACE.

On

## UTERINE SURGERY.

WITH SPECIAL REFERENCE TO THE

### MANAGEMENT OF THE STERILE CONDITION.

By J. MARION SIMS, A.B., M.D.

LATE SURGEON TO THE WOMAN'S HOSPITAL, NEW YORK.

Fellow of the New York Academy of Medicine; of the New York Pathological Society; of the New York Historical Society; of the New York State Medical Society; of the Royal Medical

**NEW YORK:**

WILLIAM WOOD & CO., 27 GREAT JONES ST.

1872.



possible, and for this reason the patient is rolled over on the front, making it a left lateral semiprone position. The nurse or assistant standing at her back pulls up the right side of the nates with the left hand, when the surgeon introduces the speculum, elevates the perineum, and gives the instrument into the right hand of the assistant, who holds it firmly in the desired position. .

FIG. 32. Title page and preface page from Sims' book in which he describes the "Sims' position."

Continued from p. 82

During the Civil War, for political reasons Sims moved to Europe where he resided in London and Paris for six years.

Due to the fact that outsiders were stopped from visiting his clinics and that his plea to admit cancer patients to the hospital was denied, Sims resigned from the Woman's Hospital in 1874. He had no further connections with this institution until shortly before his death when he again became a member of the consulting board.

In 1894 European and American admirers erected a statue to the memory of James Marion Sims, in Bryant Park, New York City.

A Memoir of James M. Sims (Emmet) Appleton, 1884. A Story of My Life (Sims). N. Y., 1884.

AM. J. SURG., 6: 561-565, 1929.

*Am. J. Obstet.*, N. Y. 17: 52-61, 1884.

*New Orleans M. & S. J.*, 23: 455-460, 1895-6.

## EPONYM

## GEORGE RYERSON FOWLER

**Eponym:** Fowler's position.

The semi-sitting posture for the treatment of acute peritonitis.

**Name: Nativity:** George Ryerson Fowler, New York City.

**Birth, Death:** Born, December 25, 1848. Died, February 6, 1906.

**Connections:** His first appointment came in 1883 as Surgeon to St. Mary's Hospital at Jamaica, L. I. Four years later he was one of the two attending surgeons at the Seney Methodist Episcopal Hospital in Brooklyn.

Later, Surgeon-in-Chief to the Brooklyn Hospital.

Other hospital appointments: Consulting surgeon to the Relief Hospital of the Eastern District; to Norwegian Hospital.

For five and one-half years Professor of Surgery in the New York Polyclinic Medical School; later Professor Emeritus of that institution.

Examiner in surgery to the Board of Regents of the University of the State of New York.

Chief Surgeon of Division, United States Volunteers, being commissioned by Pres. McKinley with rank of Major.

First President of the Brooklyn Red Cross Society (1890).

Delegate to the International Medical Congress in Moscow (1897) and Paris (1900).

**Education:** Graduated (M.D. degree) from Bellevue Hospital Medical College in 1871.

Took no internship but went directly into general practice.

**Source of Eponym:** Fowler contributed his article titled, "Diffuse Septic Peritonitis, with Special Reference to a New Method of Treatment, namely the Elevated Head and Trunk Posture to Facilitate Drainage into the Pelvis; with a Report of Nine Consecutive Cases of Recovery" to the *Medical Record* of New York for April 14, 1900.

**Other Writings:** Wrote a treatise on appendicitis in 1894. This was revised and enlarged in 1900.

Associate Editor of the *Annals of the Anatomical and Surgical Society*, later the *Annals of Surgery*.

At the time of his death Fowler has completed two volumes on General Surgery.

Did important work in thoracic surgery, his name being particularly associated with the subject of decortication of the lung in the treatment of chronic empyema.

**Discussion of Eponym:** It is of interest to note that the position for which Fowler is known was first suggested by his son and assistant, Dr. Russell Fowler, as a possible aid in preventing postoperative vomiting. The senior Fowler, noting the favorable effect of the position upon a patient with acute peritonitis, made an extensive study of the reasons for the observed improvement. Dr. George Fowler, in his writings, gives full credit to his son for suggesting the elevation of the head.

The Fowler's position is at present not infrequently spoken of as the full sitting posture, while the position in which the patient's head is elevated by 12 to 18 inches is termed the modified Fowler position. From the photostat here reprinted it is seen that the original "Fowler position" is semi-sitting posture. The semi-sitting posture for use in surgery had been vigorously advocated over a hundred years before by White<sup>1</sup> whose original article shows special tables for maintaining the patients in the desired position; but it was undoubtedly the work of Fowler which popularized the postural treatment for peritonitis.

**Points of Interest:** In regard to his text on surgery it has been said: "The book is the epitome of his life; into every page of it he infused his own personality. In its clearness of diction, comprehensiveness of treatment and the practical directions for resort to surgical relief, it is unsurpassed by any book of its day."

Fowler, with the aid of his son, corrected the proof for this text but never lived to see his own book.

Fowler seemed of tireless disposition and often after full days of operating wrote, in his own library, far into the night.

# Medical Record

*A Weekly Journal of Medicine and Surgery*

Vol. 57, No. 15.  
Whole No. 1536.

NEW YORK, APRIL 14, 1900.

\$5.00 Per Annum.  
Single Copies, 10c.

## Original Articles.

DIFFUSE SEPTIC PERITONITIS, WITH SPECIAL REFERENCE TO A NEW METHOD OF TREATMENT, NAMELY, THE ELEVATED HEAD AND TRUNK POSTURE, TO FACILITATE DRAINAGE INTO THE PELVIS. WITH A REPORT OF NINE CONSECUTIVE CASES OF RECOVERY.<sup>1</sup>

By GEORGE R. FOWLER, M.D.,

NEW YORK,

PROFESSOR OF SURGERY IN THE NEW YORK POLYCLINIC; SURGEON TO THE METHODIST EPISCOPAL HOSPITAL, ETC.

THE peritoneum is virtually an enormous lymph sac, and therefore peritonitis is lymphangitis. The absorbents of the structure of the peritoneum are represented by the lymphatics, and the protection which these afford against infecting agents by exudative material thrown out (thrombo-lymphangitis) to act as a defensive barrier by blocking the lymph channels serves to preserve the life of the subject, on the one

It was during the after-treatment of a case of diffuse septic peritonitis the result of early perforation of a violently inflamed appendix directly into the peritoneal cavity and between the coils of small intestine, and in which I had placed a glass drain as well as a number of wick drains deep in the pelvis, that the line of thought above expressed occupied my mind. My assistant, Dr. R. S. Fowler, had been in the habit of treating cases of vomiting following etherization by raising the head of the bed as high as possible consistent with comfort, thus bringing the force of gravity to bear in facilitating normal peristalsis. In view of the favorable course which the case then in hand was pursuing, it was determined to adopt this as a routine procedure for the purpose of facilitating the passage of septic fluids from the general peritoneal cavity to that of the pelvis, where, according to the reasoning above outlined, it would do but little harm, comparatively speaking, and from which locality it could be more readily removed by drainage methods. This has been done, and a further experience with the method seems to bear out the favorable opinion first entertained of this measure as of value in aiding to combat the mortality in this much-dreaded condition.

The angle assumed has varied somewhat, but I insist that the elevation of the bed from the horizontal shall be at least from twelve to fifteen inches. In order to prevent the patient from sliding down in the bed a large pillow is placed folded beneath the flexed knees, and upon this the buttocks rest. The pillow is prevented from sliding by a piece of stout bandage

passed through at the folded portion and secured to the sides of the bedstead.

The following is a list of the cases consecutively treated by this method to date:

CASE I.—October 17, 1899; Brooklyn Hospital. Diffuse septic peritonitis from a combined appendicular and adnexal lesion, originating, in all probability,

FIG. 33. Page from the *Medical Record* for April 14, 1900, containing Fowler's article in which he describes the "Fowler position."

*Continued from p. 84*

On February 2, 1906, while on a train bound for Albany, N. Y. to conduct examinations in surgery, Fowler was suddenly seized with acute abdominal pain. He was taken to a hospital in Albany where he directed that the surgeons do as they saw fit concerning his illness. He was operated upon for acute appendicitis but died on the fourth day from paralytic ileus.

<sup>1</sup> White, E. C. A treatise on the Management of Pregnant and Lying-in Women, and the Means of Curing, but More Especially Preventing, the Principal Disorders to Which They are Liable, etc. London, 1773.

See also Cutter I. S. Landmarks in surgical progress. *Internat. Abst. Surg.*, 47: 495, 1928.

*New York State J. Med.* 6: 250, 1906.

*Med. Rec.*, 29: 227, 1906.

*Surg., Gynec. & Obst.*, 37: 564, 1923.

*AM. J. SURG.*, n. s. 6: 685, 1929.

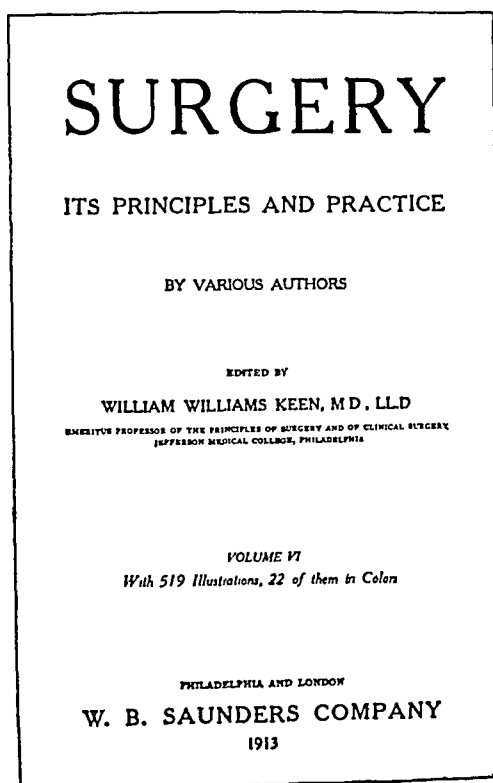
Special  
References:



## EPONYM

## JOHN BENJAMIN MURPHY

- Eponym:** Murphy's method of bimanual comparative abdominal palpation.
- Name:** John Benjamin Murphy. Appleton, Wisconsin, U. S. A.
- Nativity:** Born, December 21, 1857. Died, August 11, 1916.
- Birth, Death:**
- Connections:** First appointments were to the surgical staff of the Cook County Hospital and the Alexian Brothers Hospital of Chicago.  
 Professor of Surgery, Northwestern University (1905-1916).  
 Taught surgery also in the University of Illinois, and Rush Medical College.  
 Regent and one of founders of The American College of Surgeons.  
 Originator and editor of the volume on Surgery in American Year Book series; also of *Surgical Clinics*.  
 Honorary member of several foreign surgical and scientific societies.
- Education:** Graduated at age of twenty-two from Rush Medical College.  
 For eighteen months an interne in the Cook County Hospital.  
 Practiced medicine and surgery with Dr. Edward W. Lee for two years.  
 Subsequently spent twenty months studying in Germany.  
 Granted the Lartare medal by the University of Notre Dame in 1902.  
 Granted LL.D. degree by the University of Illinois, 1905.  
 Granted D.Sc. degree by the University of Sheffield, England in 1908.
- Source of Eponym:** Chapter on The Surgery of the Veriform Appendix in Keen's Surgery, Phila., Saunders, 1913, vol. 6.
- Other Writings:** Murphy wrote voluminously, his writings appearing in current journals and surgical textbooks. (See index library of Surgeon Generals Office.)  
 Murphy was one of the first to recognize the importance of early diagnosis and early operation for acute appendicitis. He did pioneer work on the surgery of the gall bladder, alimentary tract, blood vessels, chest, bones and joints.  
 It has been said "there is not one branch of general surgery which has not profited by his genius."
- Discussion of Eponym:** Five special tests of value in differential diagnosis were proposed by Murphy; first percussion (kidney); hammer stroke percussion (gall bladder); deep grip palpation (gall bladder); piano stroke percussion (free peritoneal fluid); and comparative bimanual examination (moderate degrees of rigidity).  
 Murphy's name is associated with still other diagnostic and therapeutic measures. See also the Murphy button; the Murphy drip.
- Points of Interest:** "The personality of John B. Murphy was so brilliant, so striking, so forceful and intense, and still so attractive, that all who came in contact with him instantly recognized the presence of a remarkable man." (Ochsner.)  
 "Among those who knew him well he was admired and deeply respected rather than loved. Except to a very few he was not genial nor responsive in friendship . . . Murphy was beyond question the greatest clinical teacher of his day, anyone who listened to him can never forget the experience." (Moynihan.)  
 Murphy conducted a clinic for students and practitioners which became world renowned and his great ability brought to him a stream of rare and difficult cases.  
 Murphy was faithfully aided in his researches by his wife (Jeanette C. Plamondon). Mrs. Murphy anesthetized all of the animals used in the extensive experiments on bowel anastomosis and at all times acted as assistant and companion.
- Special References:** The American College of Surgeons dedicated to John B. Murphy the first unit of their permanent home in Chicago (1924).  
*Surg. Gynec. & Obst.*, 23: 234, 1916.  
*Ibid.*, Vol. 31: 549, 1920.  
*Trans. Am. Surg. Assoc.*, Phila., 36: 42-44, 1918.  
*Am. J. Obstet.*, Vol. 85: 299-305, 1917.  
*Cleveland M. J.*, 15: 532, 1916.



CHAPTER CXXVI  
THE SURGERY OF THE VERMIFORM APPENDIX<sup>1</sup>

By JOHN B. MURPHY, M.D.,  
CHICAGO.

And, finally, attention is called to one other method. It is the most simple and should be used by every careful examiner. The simultaneous palpation of the two sides of the abdomen is a method which, where there is acute inflammation, gives greater resistance

to the examining hand. We palpate first the healthy side and then the other, and see quite a difference, especially in typical cases, but Murphy has pointed out and proved by clinical results during the past twenty years (since 1889) that decidedly more information is gained when both sides are palpated simultaneously. Compare the way in which the examiner's left hand sinks into the patient's iliac fossa to the lessened descent of his right hand on the side of the inflamed appendix. The difference is grossly apparent in the typical cases. So it is with the slightly involved appendices, those cases with slight recurring attacks, the atypical cases, that this test is most serviceable. An equal pressure on the two sides at the same time, "comparative bimanual examination" will show a difference which, with practice, is discernible in practically all cases where there exists an acute pathologic condition within or around the appendix.

The symptoms of acute appendicitis are as follows, and occur practically always in the same order:

- (1) Pain, primarily in the epigastrium and later at the site of the appendix.
- (2) Nausea or vomiting usually coming on a few hours after the onset of pain and only repeating the attack a few times. It never precedes the pain.
- (3) Local sensitiveness and muscular rigidity over the site of the appendix, showing markedly when contrasted with the opposite side.
- (4) Elevation of temperature, coming on three to twenty hours after the onset of pain.
- (5) Leukocytosis is present in about 97 per cent of the cases. When absent, there may be a marked elevation of temperature.

FIG. 34. Title page of book and page containing Murphy's description of bimanual comparative abdominal palpation.

## QUESTIONNAIRE

1. What constitutes the floor or lower boundary of the abdomen?
2. Bound the pelvic inlet.
3. What is the pelvic diaphragm? Its action?
4. Why is the pelvic floor of interest to the abdominal surgeon?
5. Describe the relation of the rectum to the peritoneum.
6. What peritoneal abnormalities may be discovered by rectal examination?
7. What is meant by "a transcelomic malignant transplant"?
8. Give a technic for the rectal digital examinations.
9. What various positions may be employed in making a rectal examination?
10. Describe the Sims' position. The lithotomy position.
11. Describe the method for passing a sigmoidoscope.
12. What are the normal curvatures of the rectum?
13. What structures normally felt upon rectal digital examination may easily be mistaken for tumors?
14. What are the advantages of rectoabdominal palpation?
15. Explain why foreign bodies passing through the anus may reach higher levels within the enteral canal.
16. Name the evidences obtained through alvine discharges of biliary disease, pancreatic disease, ulceration within the bowel wall.
17. What is a pelvic peritoneal hernia?
18. How may small bowel be injured in the treatment of procidentia recti?
19. What is meant by rectopexy? By archocele?
20. Is the peritoneal cavity an open or a closed space?
21. What is the pathogenesis of pneumococcus peritonitis?
22. What is the most striking contrast between the walls of the upper and lower divisions of the trunk?
23. Give the derivation of the following words: chest, thorax, abdomen, belly, venter.
24. What is the ventriculus?
25. Name the muscles of the abdominal wall.
26. Give a list of the skeletal muscles of the body wall which may show reflex muscular rigidities due to intra-abdominal disorders.
27. With what muscles must an operator deal in entering the abdominal cavity at various points?
28. Name the muscles covering the abdominal cavity on its (a) anterior and lateral walls, (b) its posterior walls, (c) its floor, (d) its roof.
29. Trace some of the nerve pathways through which abdominal organs are connected with skeletal muscles.
30. What cord levels are connected with the prevertebral ganglionic chains of the thoracolumbar division of the involuntary nervous system by means of the white rami communicantes?
31. Through what cord levels are afferent stimuli arising from the ureter in renal colic chiefly relayed to skeletal structures?
32. From what cord levels do the muscles of the upper extremities receive their motor neurones? The lower extremities?
33. What muscles connect the lower extremity with the pelvic girdle and trunk?
34. What skeletal muscles are in reflex association with afferent stimuli arising from the central portion of the diaphragm?
35. What skeletal muscles are in reflex association with peripheral portions of the diaphragm?

36. Give the innervation of the muscles reflexly associated with abdominal organs. What is the posture assumed from the continued contraction of each of these muscles?
37. Describe the technic of an examination for abdominal rigidity.
38. What is meant by "comparative bimanual abdominal palpation"; its advantages?
39. What is meant by "palpation of the indrawn abdominal wall"?
40. What is meant by "palpation with the depressed costal arch"?
41. What is the diaphragmatic phenomenon?
42. What is Litten's sign?
43. What is the cause of dyspnea as observed with acute biliary colic?
44. What abdominal organs may give rise to reflex spasticity of muscles of respiration?
45. Give four methods by which spastic contraction of one side of the diaphragm may be detected.
46. Since reflex spasticity of muscles of respiration may be caused by both intra-abdominal and extra-abdominal disorders, how can the determining factor be ascertained?
47. What is meant by the "subinguinal syndrome of renal colic"?
48. What are the effects of spasm of the cremaster muscle?
49. What is the significance of cremaster spasm in a differentiation of acute appendicitis from renal colic?
50. What is the ureteral cutaneous triangle of the thigh?"
51. State the postural effect of spasticity of the quadratus lumborum muscle.
52. What is the relation between spasm of the iliopsoas muscle and acute appendicitis?
53. What is the psoas test?
54. Explain the muffled voice often noted during acute attacks of colic.
55. How can intra-abdominal muscles reflexly effect the eye or ear?
53. What are viscerovisceral phenomena? Visceromotor phenomena?
57. Differentiate a visceromotor reflex from a peripheral nerve irritation. Give nerve pathways for example of each.
58. How is the abdomen supported by the skeleton?
59. What bones belong exclusively to the abdominal division of the trunk?
60. Distinguish between the skeletal supports and the skeletal protections of the abdomen.
61. What bones serve directly to protect abdominal organs?
62. How many ribs, or parts of ribs, overlie the abdomen?
63. What percentage of the abdominal cavity is covered by bone?
64. How closely do the lower ribs approach the iliac crests?
65. What abdominal viscera are normally palpable?
66. What is meant by "mesenteric ileus"?
67. What is the intercostal angle?
68. Of what importance is the intercostal angle to the surgeon?
69. Why is the intercostal angle found in visceroptotic individuals?
70. What is the relation between incomplete rotation of the intestine and congenital visceroptosis?

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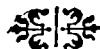
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## A CLINICAL CONSIDERATION OF INTESTINAL OBSTRUCTION\*

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NEW ORLEANS, LA.

THE salvation of human life," says Lord Moynihan of Leeds, "is a greater thing than the establishment of a convincing, irrefutable clinical diagnosis," and Arthur Curtis remarks, in another connection, that "it is better to have a less accurate diagnosis and a more favorable prognosis." There are possibilities of danger in these aphorisms, I admit, but if they were steadfastly borne in mind we should see a prompt reduction in the mortality of at least one clinical entity. I have reference to intestinal obstruction, a condition in which the lowest mortality is achieved not by the conservative surgeons who operate only on definite diagnoses and for whom, ordinarily, we have only praise, but by that other group of surgical enthusiasts whose resort to the knife is immediate and for whom, ordinarily and properly, we have only condemnation. Their craftsmanship may be dubious, their surgical judgment is unquestionably dubious, but in this one contingency, at least, we would do well to emulate them, for they lose the fewest patients from this deadly disease.

For surgery is the one treatment, the only treatment, for intestinal obstruction. Exploration is warranted on the barest suspicion that it exists. A properly made exploratory incision seldom does harm, and surely it is a better thing to open the abdomen and find nothing than to open

it after days of delay, when a moribund patient carries his diagnosis on his face, and find pathology which, because priceless time has been lost, no amount of surgical judgment and no exhibition of surgical dexterity can possibly remedy.

The logic of immediate operation is apparent if we reflect upon the true nature of intestinal obstruction. Its pathology is purely mechanical in origin, and mechanical faults can be rectified only by mechanical means. The spontaneous formation of a fecal fistula or the spontaneous correction of the obstruction are possibilities too remote to be seriously considered. The patient who is not operated on is going to die. He may die anyway, he will certainly die if surgery is delayed too long, but that is no reflection upon surgery. It is, however, a decided reflection upon the quality of the surgical judgment that deferred its performance.

You know the incidents of the sorry story so well that I need not linger upon them. The patient, seized with abdominal pain, resorts to purgation, the great cure-all of the laity. When he grows no better he calls in the medical man, who experiments with further purgation, with opiates, with fine-spun laboratory tests and other time-consuming measures. Eventually the surgeon is summoned, the surgeon who is quite as prone to delay as is his medical confrère but who escapes a good deal of opprobrium because in most instances

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he is not in at the start. Finally operation is resorted to, and operation, late in this disease, is most often the gesture of despair. It is done, as Lincoln Davis vividly says, not with any special hope of saving the patient but simply because the ethics of the profession does not permit one to operate for "a batting average." Even in the early stages of intestinal obstruction the patient is much sicker than he looks, and in the late stages he is plainly so ill that no medical knowledge is necessary to assert that here is a human being beyond the hope of succor.

At this point I am minded to refer, although with considerable trepidation, to a tendency widely current in this age of research, the tendency to lose sight of the clinical aspects of this condition, as of many others, under the weight of laboratory details. I hope that you will not misunderstand me. I have only the highest praise for the work that has been done by such investigators as Whipple, Stone, Scholefield, Hermann, Gatch, Trusler, Ayres, Foster, Haden and Orr. It has been of incalculable aid in determining pathology and in establishing a therapeutic rationale, and almost without exception the men who have done it have preached and taught that nothing which they have discovered, nothing which they hope to discover, can obviate the necessity for speedy operation in every instance of intestinal obstruction. But, consciously or unconsciously, much of their work has been distorted and made to seem a justification for procrastination. Certain of the profession, at least, have tended to dwell on the experimental work done on laboratory animals, on the exact nature of the toxins elaborated in the bowel, on the precise causes of death, forgetting that in the final analysis the only important aspect of this disease is its clinical aspect. Our chief concern must ever be with the damaged bowel wall. A knowledge of the lethal agents present may be important, but surely it is more important to dwell upon the early clinical manifestations, the

prompt recognition of which will remove any necessity for studying their terminal results. Moreover, conditions produced experimentally in animals by no means parallel conditions actually present in humans, and it might be well, at least occasionally, to pay less attention to mice and more attention to men. Finally, in this disease preeminently, the pathology of the living is a study of considerably more value than the pathology of the dead, and a deeper concentration on it would undoubtedly mean that the autopsy room would furnish us with fewer examples of it.

The protean character of intestinal obstruction is very often overlooked. It is anything but a simple disease. It is true that in the beginning, unless there is immediate circulatory damage, the picture is one of a simple blockage of the fecal current by some mechanical obstruction. But once the pathology has lasted an appreciable time, even those cases which have begun as simple obstructions merge promptly into the vascular type. Then, with interference to the circulation, come damage to the bowel wall, gangrene, necrosis, even perforation with consequent peritonitis, and the elaboration of a toxemia which is perhaps the most serious feature of all. In short, intestinal obstruction is a disease which remains localized only a very little while, and in which constitutional changes of the gravest sort come to pass within an amazingly short space of time.

It follows, then, that in a disease of such potential gravity the promptest diagnosis and treatment are essential. But this is not as simple as it sounds. The symptoms and physical signs are inconstant and variable, and diagnostic methods are far from conclusive. In practically no early case is the full classic syndrome apparent, and, as a matter of fact, when it does appear the patient is very likely to be near his death agony. The surgeon who operates for obstruction only when the diagnosis is confirmed by

the full complement of symptoms may achieve an enviable reputation for diagnostic acumen, but it will be in the autopsy room, for he will have few living patients to his credit.

Pain, the earliest symptom and the most constant, is, I would say, the inevitable concomitant of intestinal obstruction. I would remind you, however, that the abdominal viscera are largely insensitive, even when they have become pathologic, and that a proper comprehension of the mechanism by which pain is produced is even more essential in this case than it is in most other abdominal diseases. Only in rare instances is exact localization possible. The pain most usually originates vaguely about the umbilicus, less often in the epigastrium, but finally the whole abdomen is implicated. The character is quite definite. If the mesentery is involved the pain is continuous from the outset. Otherwise it begins in a colicky and intermittent fashion, and it becomes continuous only when the disease has progressed beyond the first stages. Be not deceived, either, by its subsidence. That in itself may be a most misleading thing, for it may portend the development of gangrene and not the abeyance of pathology.

Vomiting is by no means the constant symptom which pain is. In obstruction of the small bowel it is present from the start, at first as a reflex phenomenon, later because of a hypersecretory activity of this normally very active portion of the intestine, an activity which may be increased, aside from the obstruction, by misguided efforts to force fluids by mouth. In colonic obstruction, on the other hand, vomiting is usually a late symptom and it may never appear. At first the vomitus consists of gastric contents, then of bile-stained fluid, and finally of true fecal matter, unless this latter development is prevented by the fact that the small bowel obstruction acts upward as well as downward. There is no more misleading symptom than this same fecal vomiting,

and I am in hearty accord with the writers who contend that the term should be removed from the vocabulary of intestinal obstruction. It is absolutely diagnostic of obstruction, but it is likewise absolutely prognostic of impending death, and for my own part, I have never seen a patient recover in whom true fecal vomiting had been exhibited.

Since the very term intestinal obstruction carries with it the implication of a stoppage of the fecal current, it might be expected that absolute constipation would be a definite and immediate symptom. This is far from the truth. The higher the obstruction, the less likely is constipation to be evident promptly, and it must be remembered, too, that in intussusception and mesenteric thrombosis, frequent thin, watery, blood-stained stools are more likely to be the rule. It is often urged, in this connection, that, as a diagnostic measure, two enemata be given, the first to empty the bowel, the second to demonstrate the obstruction. Aside from the fact that this is a time-consuming procedure, it may not serve the purpose at all, for in a high obstruction even mechanical means may not fully or promptly empty an overloaded lower bowel. Moreover, unless there is complete relief of symptoms simultaneously, the mere passage of feces cannot be accepted at its face value. More to the point is the suggestion of Codman, that digital rectal examination be done routinely, which will reveal an empty rectum in which the walls crowd around the finger, while above is a sensation of tremendous intra-abdominal pressure. Quinn emphasizes the same point, declaring that it is more important to insert a finger in the lower end of the alimentary tract than a thermometer in the upper.

Distention is the promptest and most conspicuous physical sign, but again it is an inconstant manifestation and a late one, except in volvulus of the sigmoid, when it may be prompt and alarming. Tenderness is never apparent until after distention

has occurred. Rigidity is evident only when localized peritonitis has set in, and in marked toxemia, when the muscular defense is lacking, it may not appear at all.

Visible peristalsis is pathognomonic, but it can be demonstrated only occasionally and late. Audible peristalsis, however, is a different matter, and many agree with Deaver that auscultation of the abdomen, either with the naked ear or with the stethoscope, should never be omitted. In the early stages, as he points out, there is a hyperactive, noisy, whirring peristalsis, which ceases absolutely at the point of obstruction. In the second stage there is a high-pitched, bell-like tinkle, due to gas and fluid moving in a tubular space. And in the final stage there is the "ominously silent" abdomen, in which all activity has ceased and in which the only sound is the pulsation of the aorta. Bayley of Los Angeles describes another sign which I have nowhere else seen mentioned. He claims that in certain early cases, as the result of free fluid under tension, the heart sounds may be transmitted through the abdomen and heard in any or all of its four quadrants. Unfortunately, while this sign is almost pathognomonic, it is inconstant and is therefore of value only in conjunction with other findings.

Elevations of temperature, as would be expected in a condition that is not primarily inflammatory, are never apparent in the early stages of intestinal obstruction, at which time normal or distinctly subnormal temperatures are the rule. The pulse, on the other hand, tends to rise speedily, and this fact, taken in conjunction with the low temperature, is an important diagnostic point. Shock is apparent from the first when the circulation is affected, is always associated with distention, no matter what the primary cause of the obstruction, and is always a part of the toxic picture of the final stages. The blood pressure of these patients, therefore, must be carefully watched from the outset.

A routine urinalysis is, of course, impera-

tive, but otherwise the laboratory offers small aid, except of a negative kind, in the early case. The blood count, unless the circulation is affected, remains within normal limits until inflammatory changes have set in. Continued vomiting eventually produces definite body changes, the most marked of which is a disturbance of the blood electrolytes, depending largely upon the location of the obstruction. Blood studies will often show a loss of chlorides, a rise in the non-protein blood nitrogen, and a rise, sometimes to extraordinary figures, of the  $\text{CO}_2$  combining power of the plasma. These changes, however, occur too late to be of diagnostic value, and there is small ground for the suggestion, occasionally advanced, that the indications for operation in intestinal obstruction should be based upon repeated tests of this character. Renal damage is evident late, not only in the laboratory findings, but in the lessened fluid output, sometimes amounting to actual anuria. Indeed, in the absence of an adequate history, a patient in the last stages of intestinal obstruction could, from the clinical picture, quite logically be treated for uremia, and I have more than once seen this happen, the true lesion being discovered only at necropsy.

Although I am strongly opposed to the administration of a barium meal in any suspected intra-abdominal pathology, I am heartily in favor of the use of the x-ray as advocated by Case of Chicago. The patient is examined, preferably in the standing position, and the relative levels of gas and fluid are studied as soon as the plate can be developed. This procedure takes but a short time, and in the hand of a skilled roentgenologist it can be very valuable in the elucidation of obscure cases.

The diagnosis of intestinal obstruction, it is clear, must be made with a very confusing array of symptoms and signs, and with very uncertain methods of diagnosis. Yet it must be made promptly, for, as we have said, this is one disease in

which literally moments count, in which the development of the classic syndrome is an almost certain sign that the patient has passed beyond mortal aid. What should be our procedure in this grave hour? First, there must be a careful history, with special reference to past surgery and similar past attacks. Intestinal obstruction is very often a bolt from the blue, but it may have definite antecedents, the chief of which is a story of previous surgery especially for pelvic disease or for appendicitis with drainage, for these two types of operation are estimated to furnish from 20 to 40 per cent of all intestinal obstructions. The history of the present attack, with the character and chronology of the symptoms, is equally important. Then must come a physical examination sufficiently general to eliminate intercurrent disease, sufficiently detailed to investigate all areas of the abdomen, all hernial openings, all rectal pathology, and, in a woman, all pelvic pathology. A urinalysis and a blood count should be routine, and blood may be taken for chemical study, though, as I have said, there is no justification for delaying operation until this type of investigation can be concluded. Finally, all of the findings must be carefully weighed and evaluated, there being always, well to the fore, the recollection that any patient suffering from intra-abdominal distress may be suffering from intestinal obstruction, and that the possibility is not such a remote one at that.

The important thing is to recognize that an obstruction is actually or possibly present, or that some other definitely surgical intra-abdominal pathology which resembles it is actually or possibly present. A differential diagnosis, while desirable, is not essential, for the reason that if cardiac, pulmonary and renal disease be eliminated (and their elimination is not difficult) any other intra-abdominal condition which can be confused with intestinal obstruction is amenable only to surgery. It is a safe rule to follow that any ab-

dominal pain which lasts more than six hours in a previously well person, especially if it is accompanied by any of the signs and symptoms we have enumerated, and if it is not permanently relieved by a single small dose of morphia, is evidence of a pathology which can be corrected only by operation.

The location and type of the obstruction are likewise of little moment. The small bowel is more likely to be implicated than the large, and it is Carson, I think, who points out that the higher the obstruction the more constant the symptoms, especially vomiting, while the lower the obstruction the more constant the signs, especially meteorism. Again, obstructions of the small bowel are more likely to exhibit a sudden onset, almost the only exception being volvulus of the sigmoid, while obstructions of the large bowel are more likely to present a previous history of digestive disturbance. Herniae, at least of the external variety, carry their own diagnosis. The history of a previous operation is highly suggestive of the existence of bands or adhesions. Impacted gallstones are always preceded by a typical history of digestive disturbance, and the same history, plus loss of weight, suggests malignancy of the large bowel. This is probably the most common cause of obstruction in the aged, and it almost always presents itself as an acute obstruction superimposed upon a chronic one. Rapid and enormous distention, sometimes to the point of respiratory embarrassment, is pathognomonic of volvulus of the sigmoid. Mesenteric thrombosis is prone to occur in middle-aged individuals, more commonly men, of a phlethoric type, and to be associated with immediate shock and a raised leukocytosis. All of this, however, though interesting and gratifying from the standpoint of diagnostic acumen, is beside the point. The conviction of intestinal obstruction, or the suspicion of it, is the one thing that is needful.

While the diagnosis is being considered,

the important thing is to stay one's therapeutic hand, to restrain one's "philanthropic propensities." This is not always easy. An anguished patient and an anxious family may be insistent for relief, but this is one set of circumstances in which nihilism is true wisdom. Opiates serve only to mask symptoms, and purgatives, as Haggard well observes, simply "compound the felony of delay." By increasing a peristalsis that is already too active they serve to augment the distention of the overtried bowel, and to increase its bacterial activity, while if the stomach, and very properly, refuses to tolerate them, the body, as the result of increased vomiting, is still further depleted of its fluids.

At operation three principal problems arise: the correction of the actual obstruction, the management of the damaged bowel, and the combating of toxemia. In most early cases, unless an associated paralysis complicates the issue, simple relief of the obstruction is sufficient, but in advanced cases, as we have already pointed out, considerably more is involved than the interruption of the fecal current. Moreover, we must guard against harming the patient by the very means we employ to relieve him: in the late stages of the disease the mere relief of the obstruction is fraught with danger, permitting, as it does, a rush of toxic substances into the hitherto intact bowel or the return of the circulation to an already necrotic loop. Finally, even if the patient be relieved of his toxemia by drainage of the bowel and other adjuvant measures, he may still die of the unrelieved primary obstruction which, in his critical condition, it would be fatal to attempt to rectify.

It is plainly impossible to speak categorically of a disease in which each case must be judged upon its own merits. For working purposes, however, we can advantageously employ Sir William Taylor's very logical classification of cases, based, as is so much in this dread disease, on its duration. The condition of the patient is the determining

factor in deciding upon the type and extent of the procedure. In the first group he is seen early and operated on promptly; his condition is good, and simple relief of the obstruction most often suffices for a cure. In the second group he is seen later; his condition is still fairly good, but toxemia is either an actual or a strongly probable complication, and drainage of the bowel is done in addition to relief of the obstruction. In the third group he is seen late, indeed often he is frankly moribund, and his toxemia is so overwhelming that the primary obstruction is lost sight of. Operation is done only because even a dying patient deserves his chance for life, slender though that chance be. Drainage of the bowel, through the first presenting loop of jejunum, is the only procedure warranted. If the patient survives, and most often he does not, the primary obstruction can be dealt with at a later date.

The high mortality reported after enterostomy, either alone or combined with other procedures, is no more an argument against it than is the high general mortality of intestinal obstruction a reflection on its surgical management. It is employed only in frankly bad risks, and where control series have been fairly studied, a definite reduction in the mortality has always been noted. Moreover, jejunostomy, if done by the Witzel technic, escapes the disadvantages usually attributed to it, the loss of digestive fluids and the development of fistulae which require later tedious closures.

As to other procedures, invagination and plication of gangrenous or suspicious areas of the bowel wall is a dangerous operation (indeed, a gangrenous bowel, whether drained or undrained, should never be left within the abdomen) and its apparent conservatism results in a higher mortality, in most instances, than the frankly radical procedure of resection. The latter, many surgeons believe, is indicated in every case in which distention and toxemia, with their consequent paraly-

sis, play a part, but except in very high obstructions, when loss of the digestive fluids would be a serious consideration, the two-stage operation is better than immediate anastomosis.

Operation for intestinal obstruction, I need scarcely point out, is anything but a simple procedure. The utmost manual dexterity is necessary, for, as Bunnell says, every manipulation, necessary or unnecessary, is "a shove nearer the grave." The least that can be done is the safest for the patient. It may be a highly satisfactory thing to complete a perfect operation, but it is a highly unsatisfactory thing to complete it on a corpse, and these patients have a disconcerting way of dying on the table, under one's very hands. In short, surgical judgment here comes into its own. To speak very bluntly, only an experienced surgeon has a right to undertake operation for such a condition as this, in which craftsmanship means much, in which knowledge means much, but in which wisdom, which is the application of knowledge, means even more. Like Lord Moynihan, I stand amazed at the ready acceptance by patients "of the eager ministrations of incompetent operators," when it would be quite as easy to secure adequate skill and experience, both of which are here taxed to the limit.

In the average case of intestinal obstruction there is no time for the rehabilitation of the patient, at least as we commonly understand the term. Two things, however, must not be omitted. Gastric lavage must be instituted and must be repeated until it returns clear, and it is a wise precaution, too, to leave the tube in situ during anesthesia, lest, when the glottic reflex is obliterated, the patient drown in his own secretions, or lest, later, he develop an aspiration pneumonia. Parenthetically, I might add that in spite of all the arguments against it and in spite of all the advantages claimed for other types, my own preference is still for general anesthesia, even for ether, admittedly the least

auspicious of them all. In both local and spinal analgesia, it seems to me, the inevitable prolongation of the operation and the inevitable additional manipulations and trauma, which increase the shock of an already badly shocked patient, outweigh all the advantages claimed for them.

In the second place, hypertonic salt solution must be promptly given, preferably by infusion, to restore the fluid balance and to replace the lost chlorides, if this loss can be demonstrated; otherwise isotonic saline, as suggested by Selling Brill, may be employed instead. The use of saline, altogether with infusions of glucose and insulin, is continued after operation as long as the indications, based on the patient's clinical condition and the laboratory findings, warrant it. Other postoperative measures are employed according to the exigencies of the special case.

One or two other therapeutic measures might be briefly mentioned. B. W. Williams and Zachary Cope in England, and Bower and Clark in America, have reported striking results in a limited number of cases by the use of anti-gas serum. Williams first called attention to the striking likeness between gas gangrene and the terminal toxemia of intestinal obstruction and suggested that this similarity might be due to the actual presence of the toxins of *B. Welchii* in the fecal contents above the obstructed bowel.

Wagner in 1922 first pointed out the application of the effect of spinal analgesia in increasing intestinal peristalsis, and since that time this measure has been employed sporadically to overcome the paralysis of intestinal obstruction. The results have been very uneven and the issue has been clouded by the bad effects inherent in this special agent. Working from these premises, Ochsner and Gage, of the Department of Surgery of Tulane University, have recently suggested the substitution of splanchnic analgesia for spinal, on the ground that it is free from the disadvantages of the latter type, and

that, if the method of Kappis be employed, it is not necessary to open the abdomen to administer it. Their claim is that in those cases in which paralysis continues after relief of the obstruction, with or without drainage of the bowel, the mechanism being the inhibition of intestinal motility resulting from impulses passing by way of the sympathetics, this type of analgesia will overcome the paralysis by blocking the reflex and thus abolishing the inhibition. It must, of course, be employed only after mechanical relief of the obstruction. Prior to that time there is present a hyperperistalsis, and there is no advantage to increasing it. If the clinical application proves as satisfactory as the experimental work has been, we have reason to hope that we shall have in our possession a most valuable weapon with which to combat the hitherto invincible paralysis of intestinal obstruction.

The conclusion of the whole matter is that the prognosis of intestinal obstruction, as well as the rationale of its treatment, is absolutely dependent upon the time element involved. The mortality

rises approximately 1 per cent with each hour of procrastination, and any mortality over 10 or 12 per cent can be charged only to delay. The death rate, which is popularly quoted as 30 or 40 per cent, actually is 55 or 65 per cent, and we are only stultifying ourselves when we refuse to face the true figures. In fact, it is very little lower today than it was forty years ago, when Fitz and Senn did the pioneer work in its study, and when medical treatment for forty-eight hours was the accepted rule. Medical treatment is not the rule today. Surgery is universally admitted to be the only rational and possible treatment. The trouble is, however, that in a lamentable number of cases our practice does not accord with our theory. And it is this sorry state of affairs, with its resulting almost criminal mortality, which must be my excuse, if excuse be needed, for having presented to you in this paper a subject to which, I am quite aware, I have added nothing new, but which, I am likewise certain, can be clarified and elucidated only by ceaseless iteration of the tragic facts of the case.



# STUDIES IN THE EMBRYOLOGY OF BONE DEVELOPMENT\*

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**B**ONE development in the human embryo can best be understood by actually seeing the bones in situ in the various stages of development. The method used to show these changes embodies two principles, one the depigmentizing of the soft tissue, and the other, the staining of the bone tissue.

The depigmentizing was accomplished by a prolonged process through various strengths of potassium hydroxide, and the standing of the bone was done with an alcoholic extract sodium alizarin sulfonate in a 1 per cent potassium hydroxid.

Before the actual process of depigmentizing is employed, a preliminary bleaching, fixing and hardening of the material is necessary. The material, as soon as obtained, is best put into 70 per cent alcohol. Upon arrival in the laboratory, it should immediately be transferred to iodine alcohol, which is prepared by adding enough crystals of iodine to 95 per cent alcohol to impart a deep iodine color. After remaining in iodine alcohol for two days, the material should be then placed in 2 per cent aqueous potassium bichromate solution and left there in the dark room for thirty-six hours. Next, after washing in cool, running tap-water for two hours, the material is placed in 50 per cent alcohol and left there for three hours; after this, it is transferred to 95 per cent alcohol, in which it is allowed to remain for two or three weeks. During this time, the alcohol is changed as frequently as is necessary in order to keep the alcohol reasonably clear. At this stage in the preparation of the material, it is advisable to hemisect and eviscerate the fetus.

Now the material is ready for depigmentizing. The agent employed is aqueous potassium hydroxid which is changed twice a week. The percentage varies from

$\frac{1}{4}$  per cent for a very young fetus up to 4 per cent for a full term fetus. The best results are obtained when the specimen is kept in the sunlight; the reason for the favoring action of the sun's rays is not determined. The alpine rays can be excluded as a factor, because they do not penetrate the glass jars in which the specimens are contained; apparently the heat of the sun's rays is a very important factor, as determined by the fact that depigmentizing proceeds more rapidly in an incubator at 37.5 c. than at room temperature. However, it has been determined that there are bleaching rays in the sunlight which penetrate the glass of the containers, and are important adjuvants to the heat in the bleaching process.

When the depigmentation has advanced to the point that the ribs of the fetus become readily visible, the specimen should be stained. The basis of the stain is a saturated solution of sodium alizarin sulphonate in 95 per cent alcohol. Such a saturated solution has a golden color quite similar to that of the dry powder. The final staining reagent is prepared by adding the saturated alcoholic extract of the dye, a little at a time, to a 1 per cent potassium hydroxid solution, until a deep Burgundy wine color is obtained. The time required for staining varies from six to twenty-four hours, depending upon the age of the fetus. After the staining process is complete, the fetus is washed in cool running tap-water for one hour. Then the specimen is placed in a mixture of 5 per cent glycerine and a percentage of potassium hydroxid equivalent to that used for the initial depigmentation of the specimen. After remaining in this solution for several days, enough of the stain will have dissolved out of the soft tissues of the fetus to rather markedly color the solution. (From now

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on, the solution is changed at about two-day intervals, the amount of alkali at each change being very gradually reduced,

prevent fungus growth (in one specimen, there were several colonies of *penicillium glaucum*, a black mould, growing on the

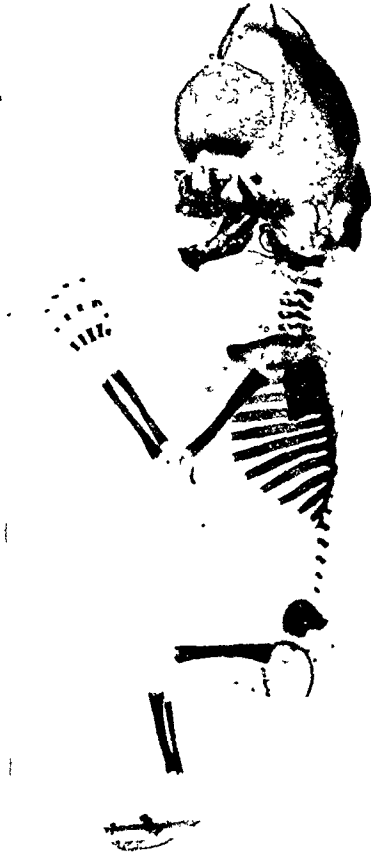


FIG. 1.



FIG. 2.

FIGS. 1 and 2. Three months' fetuses, stained. Length 9.5 cm. prior to preparation.

and the glycerine somewhat more rapidly being increased in amount. When a concentration of 25 per cent glycerine is attained, the hydroxid should be discontinued; at this stage the depigmentation should be nearing completion. After seven days in 25 per cent glycerine, the fetus is transferred to a 28 per cent ammonium hydroxide solution and left there for two days; then the specimen is put back into 25 per cent glycerine, and at weekly intervals is transferred to increasing percentages of glycerine until a concentration of 100 per cent is attained. After several changes in 100 per cent glycerine, the specimen is mounted in this latter reagent, to which is added a crystal of thymol to

100 per cent glycerine to which thymol had not been added).

Larger fetuses require some variation in the described technic. Usually after the fifth month there is much subcutaneous fat which markedly interferes with the clearing of the specimen, and requires special technic which is best employed at the end of the hardening process, before using the hydroxid. This variation consists in changing from 95 per cent alcohol to acetone, in which latter reagent it is left for several days; then to an acetone-xylol mixture and gradually increasing the xylol until 100 per cent xylol is used for several hours to several days, and then working backwards through xylol acetone to alcohol. This

method usually clears the fat, but a large amount of shrinkage of the specimen is unavoidable.

The basis for development of the bony tissue, of which there are two types, is embryonic connective tissue. In one type

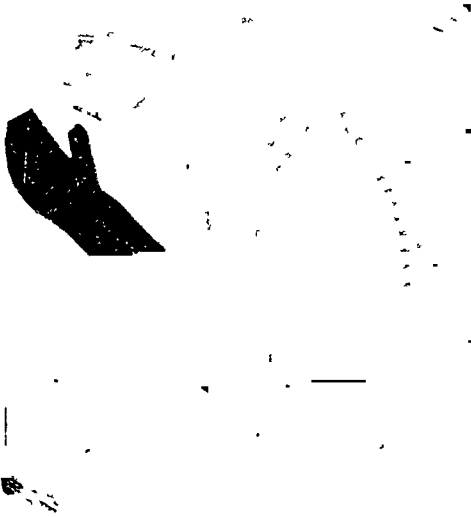


FIG. 3. Roentgen-ray of three months' fetus with resistance.

The process of depigmentation and staining is a time-consuming one. The smallest embryo, of ten to twelve weeks, requires about three months, and progressively with the increase in age of the fetus the time element is lengthened so that a full term fetus requires approximately two years for completion.

In the completed specimen, the entire bony skeleton system is visible, as well as the cartilage that has some calcium in it. One can easily distinguish cartilage from bone, the bone taking a definite red opaque color and the cartilage a brownish translucent hyaline-like appearance. The skull bones especially are brought out very distinctly. As early as the third month the tympanic ring can be seen to be definitely calcified. The ossification centers are easily traced and studied, and a truer conception of the gross difference between the cartilage and membrane bones is had from these stained specimens, than can be obtained from the finest roentgen plates.



FIG. 4. Four months' fetus, stained. Length prior to preparation 17 cm.

of development cartilage precedes the bone and in the other, membrane formation precedes the bone. In intramembranous ossification the calcium salts are deposited in ordinary embryonic connective tissue. In intracartilaginous ossification, hyaline cartilage first develops in the same general shape as the future bone and the calcium salts are afterwards deposited within the mass of the cartilage.

The membrane bones, for example many

of the flat bones of the skull and face, are ossified by bundles of connective tissue fibers becoming impregnated with calcium

teum, where the osteoblasts are numerous, thus causing growth and enlargement of the bone.



FIG. 5. Three months' fetus, stained. Length 9 cm. prior to preparation. Showing osteochondritis and poor bone calcification.

salts. These calcified bundles are calcification centers. These bundles are clearly demonstrated, especially in the younger of the stained specimens, as shown on the photographs and roentgenograms. In each of these areas, the cells increase in number, the tissue becomes very vascular and some of the cells become more oval with distinct nucleus and considerable amount of cytoplasm, then arrange themselves in single, fairly regular rows along the bundles of calcified fibers. These cells are known as osteoblasts and the whole tissue is known as osteogenic tissue. Under the influence of the osteoblasts, a thin layer of calcium is deposited between the osteoblasts and the calcified fibers. In this way true bone is formed. On the inner surface of newly formed bone, osteoclasts cause dissolution, while new bone is being formed on the outer surface especially under the perios-



FIG. 6. Enlargement of lower extremity of fetus in Figure 5, showing osteochondritis in tibia and lack of calcification in fibula.

Intracartilaginous ossification, physiologically, is similar, but for the fact that it is performed by cartilage, shaped similarly to the future bone. The ossification center is usually single in these bones (the sternum is one exception, having several centers of ossification). The ossification center is in the center of the bone, especially as seen in the long bones, and the osteogenic tissue pushes in both directions toward the end of the cartilage (in the long bones towards the epiphysis). Summarizing, ossification in cartilage consists of the following stages: (1) multiplication of cartilage cells; (2) calcification of the cartilage; (3) absorption of the

calcified cartilage, and (4) deposition of true bone, that is, calcified fibrous tissue, round cells and osteoblasts which have

certain amount of calcium carbonate is precipitated in the matrix around the osteoblasts. The identical ferment is found



FIG. 7. Roentgenogram of three months' fetus, superimposed over normal pelvis roentgenogram.

invaded the calcified cartilage from the marrow.

The lime salts are stored in the bones the same as glycogen is stored in the liver and can be taken out of bone if needed by other part of body in the same manner. The calcium is carried by the blood stream to the bone. An old theory was that the maternal blood caused supersaturation of the calcium in the fetal blood and this caused the calcium to be deposited in the bone tissue of the fetus, because circulation in this region was more sluggish. This theory, however, was not substantiated in any way, because there was no scientific reasoning behind it.

An important rôle in carrying calcium salts to the bone is played by a hexose monophosphoric ester, which forms soluble salts with the calcium. This hexose monophosphoric ester is a normal constituent of circulating blood and in turn depends on the glucose of the blood. Under the action of a ferment which is present in ossifying cartilage, this calcium salt is hydrolyzed and calcium phosphate with a



FIG. 8. Roentgenogram of five months' fetus, superimposed over normal pelvis roentgenogram.

in the intestines and kidneys. In the gut it joins the calcium, phosphate and sugar to form the soluble calcium hexose monophosphoric ester, and in the kidney it may be responsible for the secretion of the phosphate in excess.

The manner in which these various inorganic constituents are combined in bone, whether chemically or physically, is not known, but it is probable that the calcium carbonate and calcium phosphate are united, and it is possible that magnesium phosphate is included in the same molecule.

The drain on the mother's calcium and sugar is thus easily visualized. It is interesting in this connection, that after phosphorus poisoning a patient craves sugar, which no doubt is due to loss of body sugar in eliminating the phosphorus.

The true etiology of congenital variations and anomalies has not as yet been ascertained with any degree of exactness in most cases. A few years ago fright, seeing horrible sights and other superstitions were blamed for congenital defects, especially monstrosities. The conditions recognized as capable of modifying bone development are:

(a) Germinal and prenatal infection with *Treponema pallidum*

(b) Congenital rickets



FIG. 9. Roentgenogram of full term fetus (shrunk by process), superimposed over normal pelvis roentgenogram.

(c) Infarcts

(d) Oligohydramnios

(e) Chondrodystrophia fetalis

(f) Osteogenesis imperfecta

True germinal infection implies that a disease-producing microorganism is carried by the ovum or the spermatozoa and incorporated in the embryo prior to its development. It has been claimed that syphilis may thus be transmitted by the male to the ovum in utero, the mother remaining uninfected by the disease. In prenatal infection the organism must pass the placental barrier. This implies that the fetus becomes infected directly from the maternal blood stream or by continuity of growth of the organism through the placenta. The placental form of infection is not conceded by all observers, but it is reasonably certain that congenital lues can be contracted thus.

Bone lesions of late congenital lues and

acquired lues are distinctly different from those of fetal and early congenital lues. In the early type the disease affects chiefly the ends of the long bones. In late lues, it affects the flat bones with gumma and bone destruction (gumma, necrosis and caries sicca) and bone proliferation (osteosclerosis and osteoperiostitis).

A child with early congenital lues may show the deformity at birth or not until a later date, although infection may be present. The infection in all cases, except germinal, if there is such, is hematogenous.

The *Spirocheta pallida* or treponema of Schaudinn exerts certain effects on the fetal skeleton. The characteristic skeleton lesions are not seen before the fifth month according to Keith, and thus the many luetic miscarriages on the third month of pregnancy would show nothing. However, the picture of the prepared specimen of a third month miscarriage of luetic parentage shows definitely osteochondritis of the tibia (diagnosis confirmed by Dr. Archibald Murray, fetus aged three months).

The osteochondritis here is shown by the abnormal width and irregularity in shape, as well as irregular calcification of the distal end of the tibia and complete absence of calcium in the fibula. Normally a fetus of this size has well-developed bone. According to Hess, tibia and fibula are well ossified at ten weeks. The luetic condition caused the pathology already stated plus poor calcification throughout, making it possible to see on a large scale how the calcification centers appear in the other bones, which normally would have been at those stages about three weeks earlier, because of the delayed calcification. This specimen shows best when compared with the normal specimen of the same age which is shown here. In practically all prematurely born and prematurely stillborn children with congenital lues, luetic bone changes are found. These may be accompanied by skin and mucous membrane changes which appear at the eighth month of pregnancy.

One of the most important anatomical

signs of syphilis is syphilitic osteochondritis which often renders anatomical diagnosis possible, if the other symptoms pointing to lues are absent. When seen, it may be difficult to prove even clinically at times, but it is most always a sign of latent syphilis in such cases. Syphilitic osteochondritis leads to a widening and irregular formation of the zone of calcification which is indistinctly outlined against the epiphysis and sends out jagged offshoots into the latter. This lesion occurs most frequently in the distal end of the femur, then in the tibia and fibula, and then in both bones of the forearm. Osteochondritis may occur, however, in flat bones.

Levaditi, Hoffman and Bertarelli frequently found *Treponema pallidum* at or after the fifth month in osteochondrotic tissue.

Periostitis ossificans is also found occasionally in congenital lues.

Congenital rickets is thought by some to be only a congenital predisposition to rickets, while another school thinks, and has good evidence to prove, the presence of rickets in the fetus in utero, caused by the same factors as produce rickets later on.

In rickets there is accelerated multiplication of cartilage cells and a retardation in the deposition of true bone resulting from a failure in deposition of the calcium salts. It is evident that in the causation of rickets or, for the growth of normal bone, many factors are involved. In the first place, the presence of vitamin D is essential. This may, however, be replaced to a certain extent by exposure to sun's rays or to ultraviolet light. Then it is necessary that calcium salts shall be present in proper proportions. Deficiency of calcium and phosphates in diet may hinder the formation of bone.

Infarcts of the placenta may modify the development of the entire fetus, thus modifying the bone development at the same time.

Oligohydramnios might modify the development of bone, by producing intrauterine amputations or pressure deformities.

Chondrodystrophia fetalis or micromelia is shortness of limbs. Changes in the skeleton are derived essentially from retardation of the epiphyseal growth of the bone, with normal periosteal growth. The structure of the bone produced with the periosteum is very dense, and results in the coarse sclerotic quality of the bone. The formation of synostosis takes place in the synchondroses and syndesmoses. The junctions of the epiphyses close prematurely, and the further growth in length is impeded by the coalescence of the latter. The cause of the disturbance is thought to be a disturbance in the internal secretory equilibrium, with evidence that in these fetuses there are generally insignificant, but frequent changes in the thyroid, liver and genital development. However a living infant born at the Long Island College Hospital in the month of April, 1929, was typical of micromelia, especially marked bilaterally in the humeri and femora, yet apparently there were no gross thyroid, liver or genital changes observable. There was a slight degree of hydrocephalus. The mother was normal in every respect physically.

In osteogenesis imperfecta, the most characteristic symptom lies in the abnormal brittleness of the bones, and after birth such children exhibit multiple incomplete fractures, due to the thinness of the cortical bone layers. The extremities may be bent in a circle, due to fractures. Otherwise the condition of the child presents nothing abnormal. The cause of this condition is not known.

Roentgenograms may be used *per se* to determine the bone development, and the roentgen ray bears an important part in the medico-legal aspect of obstetrics. The stained specimens present detail and relationships in three dimensions, so that when used as controls, and checked over by roentgen rays, one can more fully read and comprehend the roentgen ray picture.

The stage of ossification of the skeleton of a fetus, as observed in roentgenograms, is used practically to determine the age

of the fetus. This method however is far from accurate, and this can be easily shown by comparing the two pictures of the three-month-old fetuses. One has fairly good bony development, and the other, due to diseased condition, has marked retardation in calcium deposition. The centers of ossification in the diseased specimen are almost equal to that of the normal specimen, and therefore, using the number of centers of ossification as an index to age might be more accurate. These points are much more clearly visualized on study of the cleared specimens up to four months of age, because up to this age roentgen rays are very indistinct. Using the cleared specimens as controls, the study of these centers of ossification is greatly facilitated.

Mall, through a special technic proved in specimens under 100 days old that centers of ossification are present at least one week before they are demonstrable by roentgenograms. Anatomically these observations are definitely proved by the cleared preparations.

In the very early period of the second month the stage of ossification of the clavicle and the mandible is of chief importance.

The results used for comparison are from the combined findings of several years of laboratory work, the chief details of the *modus operandi* having been stated at the beginning of this paper, supplemented by a large number of photographs and roentgenograms. The photographs were taken in a dark room by means of transmitted light. The roentgenograms required careful study so that detail and contrast could well be brought out, the best result being had with high milliamperage and increased distance of the object from the target. The smallest specimen, three months of age, was best at 40 ma. distance of 36 in. and time  $\frac{3}{4}$  sec. The full term fetus showed best at 40 ma. and 36 in. distance and the time at exposure was 2 sec. This technic gives the best black and white contrast.

#### SUMMARY

There are several possibilities for use of the data given here.

1. The observer can have an open view of the study of the progress of the development of bone in the fetus.

2. The relationship of the bones to each other and to the rest of the body can be studied in true anatomical position.

3. The results can be used in obstetrics especially in roentgen ray work, the stained specimens acting as controls as far as detail and number of calcification centers are concerned, as an aid in judging the size. The truest picture of fetal changes is obtained by a detailed study of the stained specimen, especially in the earlier months. Roentgen pictures of the fetus taken at the same period show a marked lack of detail when compared with the stained specimen. The possibilities in this are great, and a decided increase in efficiency in obstetrical diagnosis in the early months of pregnancy may be obtained by careful comparisons of the roentgen ray plates with the stained specimens, for the purpose of so perfecting the roentgen ray technic that it may bring out details which are now only observable in the stained specimens.

In the special work, roentgen rays of specimens of all ages were superimposed over the roentgen rays of the normal female pelvis, and the results are clean cut. One may argue that with the fetus in utero the conditions are different and there is greater body resistance with greater chance of distortion and absorption of the roentgen rays. There is some truth to this argument, but the results had from ordinary roentgen rays, and the roentgen rays of the fetuses when studied out carefully with regard to the various factors of distance, time and milliamperage, compared with the stained preparations, show that the earlier roentgen ray diagnosis can be made more certain.

4. Earlier determination of bone pathologies of the fetus in utero, especially of luetic osteochondritis when lues is

suspected, are made possible even though clinical data are missing.

My especial gratitude is due Dr. Adam M. Miller, Head of the Department of Anatomy at the Long Island College Hospital, who made available to me the

facilities for carrying on this work and also to Dr. Bell, Head of the Department of Radiography, through whose courtesy and cooperation the photographs and roentgen ray studies appearing in this article were made possible.

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# EMBRYOLOGY, ANATOMY AND SURGERY OF THE PROSTATE GLAND

WITH REPORT OF OPERATIVE RESULTS\*

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AMONG the various structures which make up the genitourinary tract the prostate gland has, until recent times, remained something of a mystery. By the earliest anatomists it was regarded as a urinary organ, and after its identification as a part of the generative system, its anatomy, histology and function were imperfectly understood, and its pathologic manifestations remained a vexatious problem to students of urology right up to our own time. Indeed even now many of the points that these students have from time to time brought forward for elucidation are still unsettled, and capable of stirring up a considerable amount of acrimonious partizanship when brought up for discussion, a sure proof that we have still a good deal to learn about this diminutive but highly important part of the male organism.

When I first entered upon the study of prostatic anatomy and physiology, a review of the existing literature revealed an amazing divergence of opinion, especially in the department of embryology, the particular rock upon which unanimity always seemed to be shipwrecked being the integral relationship of the "middle lobe" to the rest of the structures about the vesical neck.

## EMBRYOLOGIC DEVELOPMENT

My investigations of prostatic embryology were carried out upon specimens varying in age from ten weeks to full term, and study was further visualized by the construction of a wax model of the human prostate gland as it appears at birth.

The study was begun with a fetus 5 cm. in length, estimated age ten weeks. At this

stage of development the bladder is a cylindrical tube made up of embryonal connective tissue, joined near its base by the two ureters. These two ducts pass through the wall of the cylindrical bladder, and the muscle fibers which form them extend so as to be superimposed upon the vesical wall, thus forming the trigonum vesicae. No tissue which in any way resembles muscle is to be detected, nor can one distinguish the area which will later on be occupied by the vesical sphincter, except that alternation in the size and shape of the lumen is evident. In a fetus of thirteen weeks' development, however, this muscular development has been initiated, for circular interlacing of the fibers has commenced, longitudinal strands of tissue which take on a deeper pink color than that assumed by most of the connective tissue of the vesical wall being in evidence. The bladder base has thickened until it is deeper than any other portion of the circumference, and the wall beneath the trigonal area with the overlying trigonum vesicae has a depth five times that of the anterior wall. It is now possible to trace the trigone's muscle fibers from between the two ureters down upon the remainder of the trigone, and it is noticeable that their texture is much finer than that of the fibers of the vesical wall proper. An abrupt narrowing in the circumference of the lumen indicates where the vesical sphincter will shortly emerge as an entity and at this period of development also, a few muscle fibers displaying the circular arrangement are in evidence.

By the time the sixteenth week of fetal development is attained there is a great advance in formation of bladder muscle, the difference between muscle fibers and

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connective tissue being sharply defined. The fibers forming the vesical trigone are in evidence from their place of emergence from the walls of the ureters, so that their course to the trigone area is easily traced, and in the specimen of this age which was examined, the mucosa was smooth and closely adherent to the trigone, though elsewhere it was arranged in folds. The constricted opening of the vesical neck was sharply outlined by encircling muscular fibers indicating the position of the vesical sphincter. In a specimen twenty weeks old there is a very great increase in the number and size of these fibers, so that the internal sphincter seems to be tightly closing the vesical orifice. All the muscular fibers are much more in evidence, the longitudinal ones running in among those upon the outside of the sphincter. Though folded every where else, the mucosa over the trigone is quite smooth at this stage.

In a specimen of twenty-two weeks' development the musculature of the bladder has undergone still greater augmentation, and the same is true of the interureteric bar. The relation between the size of the trigone and its underlying bladder wall to that of the remainder of the wall of this viscus has now changed, for this part of the wall has not enlarged as rapidly as other sections; the fibers forming the trigone show a closer binding together than those of the rest of the bladder, while the mucosa covers it smoothly; the sphincter, though large, is in very close relation to the rest of the vesical musculature. At the thirtieth week and at full term the muscles of the bladder wall will be found to have increased still further in size, for at birth the sphincter is very thick in its posterior quadrant, and shows its greatest dimension at the upper margin. At this time many of the muscle fibers, instead of circling the orifice, mingle with those showing a longitudinal arrangement which originate on the anterior surface of the bladder. The fibers visible at the outermost part of the sphincter are not now so numerous,

but those in evidence entirely encircle the opening.

It is not until the third month of fetal life that there is evidence of development of the prostate gland. At this time solid epithelial outgrowths make their appearance from five distinct parts of the prostatic urethra. These solid masses are made up of cells which stain very deeply, and very early these assume a circular arrangement forming a lumen and branches and thus producing the tubules which are the prostatic nucleus. From the five different points of origin there thus arise five groups of tubules, the first lying on the floor of the urethra between the vesical neck and the orifices of the ejaculatory ducts and prostatic utricle; the second and third on on either side the urethra in the prostatic furrow; the fourth just below the point where the ejaculatory ducts and utricle open into the urethra, upon the urethral floor; and the fifth in the prostatic urethra upon the ventral or anterior wall. By the development of these tubules and their enclosure in stroma; there eventually arise five lobes, namely the middle lobe, right and left lateral lobes, posterior and finally, anterior lobe. Widely separated in the early stages of embryologic development, the distance between the middle and two lateral lobes is greatly diminished in later fetal life. None of the specimens studied showed any actual intermingling of the tubules, but after birth the middle lobe and lateral lobes lay side by side, with no definite separating capsule between them. The posterior lobe, however, was entirely distinct, a dense layer of fibrous tissue separating it from the lateral lobes, and the anterior lobe was at a considerable distance from the two lateral lobes, separation being quite complete.

The youngest fetus examined showed no sign of muscular fibers about the prostatic tubules, but at the sixteenth week a slight differentiation in staining properties was noted and by the twenty-second week there was considerable development of the muscle layers, especially at a point

where certain of the tubules of the lateral lobe extended away from the base of the prostate. This muscle structure constantly increases in thickness as older specimens are examined, until at full term an extremely dense layered structure surrounds some of the tubules.

*The Middle Lobe.* As one among the specimens examined in the course of this study had no tubules developed in the usual location of the middle lobe, the investigation was extended to adult dissection and autopsy subjects in order to determine the relative number of individuals who possess this portion of the gland under consideration. In all, 103 specimens were examined, and among these there was but one, the fetus in question, in which there was undoubted absence of glandular tissue in the middle lobe region, though in 5, 3 of which were seen at Guy's Hospital Pathological Museum, London, it was not possible to determine whether or not glandular tissue was present.

The middle lobe in all the fetal specimens examined was seen to develop independently from the group of tubules lying on the floor of the urethra, at a point between the bladder and the orifices of the ejaculatory ducts. In the younger specimens this group was a long way from those which were the origin of the lateral lobes, but as older specimens were examined, the area intervening in which no glandular elements could be detected gradually decreased until, though the tubules and their branches did not lose their characteristic position, there was no longer any distinguishable fibrous capsule separating the middle from the lateral lobes. As the structures of the verumontanum develop, the ducts of the largest tubules, originally close to the middle line, are displaced so that they open high up on its sides, their original position being occupied by the ejaculatory duct openings and that of the prostatic utricle. The average number of tubules in the middle lobe, in this study, was found to be ten.

*The Lateral Lobes.* The number and

size of the tubules composing the lateral lobes were found to be greater than in any of the other lobes. The lateral lobe tubules originate on the lower part of the lateral walls from the right and left prostatic furrows, forming the major part of the prostate's base by backward and outward extension. Though there is always a certain degree of separation between these lobes, it is much greater in the early specimens, the nearer the full term of gestation is approached, the less definite this separation becomes, except at the point where the ducts communicate with the urethra, where the distinction always remains evident. The tubules always grow back toward the bladder, except in the apical region; here a few of the lateral lobe tubules send branches in a forward direction. In the one specimen where the middle lobe was absent, branches from the lateral lobes developed into the region which the middle lobe normally occupies. In a specimen from a new-born infant, the lateral lobes displayed two tubules which branched widely, so that they formed practically a glandular commissure by extending up into the region of the anterior commissure. Usually the lateral lobes show a considerable extent of stroma between their anterior protions, anterior lobe tubules being present in this stroma. A definite plane of connective tissue lies between their posterior branches and the posterior prostatic lobe, and mesially the ejaculatory duct, the urethra and the middle prostatic lobe intervene. The average number of tubules in the two lateral lobes was reckoned to be thirty-seven.

The *posterior lobe* was found present in every specimen examined, as an independent structure developing from tubules which are distant from those from which the other lobes develop, and divided from the other lobes by a definite capsule, only connected laterally with that enclosing the entire gland. The tubules of this lobe appear at the third month of fetal development together with those of the other glands, and are found on the urethral floor

below the openings of the ejaculatory ducts. They develop in a backward direction toward the bladder, thus advancing behind the ejaculatory ducts, and forming the major portion of the prostate's apex, the portion of the fully developed gland which can be palpated by rectum. The posterior lobe is separated, by a stroma of connective tissue containing no tubules, from the ejaculatory ducts and the posterior sections of the lateral lobes, although this stroma is not in evidence in the earlier months of fetal development. In this division of the prostate gland the tubules are relatively large and have numerous branches, but they are few in number, the average in six specimens being only eight. Their branches, like those of the tubules of the anterior lateral lobes, extend forward into the apical region.

The posterior lobe of the prostate is of especial interest to surgeons, for it has been established that it is the site of carcinoma, but that benign hypertrophy seldom takes place in it. We are indebted to the late John T. Geraghty and to Montague L. Boyd for studies in prostatic pathology which have supplied us with this information, and when we add to this the further knowledge gained by embryologic investigation, which shows that the tubules from which this lobe takes its origin are entirely independent of the other tubules forming the remaining prostatic lobes, it at once appears highly probable that the function of the posterior lobe may be distinct and different from that of the remainder of the gland. This view gains further confirmation when examination of the posterior lobe tubules in the fully developed adult, shows them to be much larger than others.

The *anterior or ventral lobe* enters upon its developmental stage at the same time as the other lobes, being formed of large tubules having numerous branches. The size of these tubules, however, does not remain relatively so large, for by the time development has advanced to the sixteenth week they are even somewhat smaller than the tubules of the other lobes, and

by the twenty-second week they have decreased both in number and size, and appear to have lost most of their branches. In fact the anterior lobe becomes increasingly insignificant as development advances, until when full term is reached only two small tubules are in evidence. The anterior lobe may, however, persist to the period of full adult development, for among the adult prostates which were examined in connection with this study, numbering 93, 2 specimens came under observation in which hypertrophied anterior lobes were present. The average number of anterior lobe tubules in the fetal material examined was thirteen for the first half of the interuterine period, and six for the second half of this period. Kuznitzky reported the finding of a persistent ventral lobe in 1 out of every 15 adult prostates which he examined.

*Prostatic Duct Openings.* One of the significant results of this investigation was that relating to the number of prostatic ducts which have openings upon the floor of the prostatic urethra. In the majority of textbook descriptions the number of these openings has usually been given as from twenty to thirty. I am convinced, however, that this estimate is far below the actual average. Summing up my findings in regard to this particular point, it turned out that no specimen examined showed less than fifty-three of these ducts opening into the prostatic urethra; 2 specimens showed as high as seventy-four, and the average for 6 specimens, in one of which there was no middle lobe, was sixty-three. And never, since I first published the results of my enumeration nearly fifteen years ago, have I seen any refutation of my figures, though many textbooks, even those which have undergone revision in the meanwhile, still continue to make the original estimate.

#### SURGERY

Great progress has been made in the surgery of the prostate gland in the past few years. A review of the steps marking

progress of surgery of the prostate gland is interesting. The problem of this particular field of surgery is complicated by the fact that all of the patients are men of advanced years.

The discovery of anesthesia and the application of the principles laid down by Lord Lister placed this branch within the limits of surgical aid along the usual lines. It was soon learned that the aged men, most of whom suffered from deficiency in renal power, tolerated ether poorly and various efforts were instituted to avoid the frightful mortality that resulted from this operation under ether.

It was early recognized that those patients, who were catheterized over long periods, if they survived, were in better condition for operation when it was finally performed. This knowledge led the progressive urological surgeon to institute some sort of drainage as a routine preliminary to operation. This drainage may take one of three forms:

- (1) Regular catheterization once or twice daily
- (2) Retained catheter per urethram, or
- (3) Suprapubic drainage under local anesthesia.

Personally I prefer the last method because the other two are irritative and annoying to the patients and we find that even under the most careful precautions the patient will be inflicted with either a primary cystitis or a secondary exacerbation of an already existing infection.

The Urological Department of the New York Hospital is provided with suction in every room so that the patients are kept dry and comfortable by attaching the suction to the inner of a double tube which has been in use for many years. The urine rises in the large outer tube until it reaches the lower end of the small inner tube, which is surrounded by a column of air, and the patients abdomen is kept dry by this means without sucking the bladder wall into the end of the tube.

The general observation of the improvement in the renal power of patients by

drainage was placed on a scientific basis by the development of accurate methods of measuring kidney efficiency. These methods have gradually improved, stimulated no doubt by the epoch-making work of Geraghty and Rountree on phenolsulphonephthalein in 1908. Various other tests are in use including cryoscopy, estimation of output of various substances, such as potassium iodide, sodium chloride and others. The color tests, phenolsulphonephthalein and indigo carmine, deservedly occupy the most important place among kidney efficiency tests in the order named. The Mosenthal concentration test is an important recent addition to this list.

Perfection of methods of estimating various retention products in the blood stream of persons suffering from inefficient kidneys is a most important addition to our investigation of the patient, preliminary to operation. By determining this retention, by estimating the excretion of urea in a twenty-four hour specimen and by doing a phenolsulphonephthalein test, one may get a true picture of the extent to which the kidneys are performing their function as eliminative organs.

The most important part of any operation upon the prostate gland is the preparation of the patient. This preparation consists of drainage by any effective method that is least annoying to the patient.

The patient having been properly prepared, as indicated by his laboratory tests and as shown by the observing eye of the operator, it is necessary to decide which type of operation one must use. It seems most unwise for the urological surgeon to close his mind to any type of operation. It can be clearly decided by the cystoscope or by digital examination at the preliminary suprapubic cystotomy whether the hypertrophic gland should be removed by the suprapubic route or through the perineum. Unless there is some specific reason for the gland to be removed subrapubically it would seem much more preferable to perform the perineal opera-

tion because while the latter requires more time and an intimate knowledge of the anatomy of the region, it is not nearly so great a shock to the patient. The reason for the shock accompanying the upper route is that there is always more or less pressure and traumatism to the complicated nervous plexuses over which one must work, thereby exerting an effect similar to a blow over the solar plexus, so familiar to everyone. The downhill drainage and the fact that the patient can be gotten out of bed in a chair after the third or fourth day are additional arguments in favor of the perineal operation of Young and its modifications and the excellent perineal operations of Voelker of Halle and Syms of New York.

Next to the preliminary drainage the choice of anesthesia assumes a much more important rôle than does the choice of operation routes. Ether is dangerous because it is extremely irritative to the kidneys, which even in the best of cases are already damaged. Chloroform is almost sure death, the patients succumbing in from six to ten days as a result of liver poisoning as shown by the experiments of George Whipple. Of the inhalation anesthesia, gas oxygen is the most serviceable, but there are very definite objections to it. Under all inhalation anesthetics the blood pressure is elevated very considerable so that the patient may be likened to an athlete at the height of his activities. This naturally gives rise to more bleeding and consequently to greater shock. Many attempts have been made to perform the operation under local or regional anesthesia. Of these methods two have survived. Spinal anesthesia as practiced by many urologists from time to time in this country and sacral anesthesia which has been lately modified by the addition of parasacral injections as well. The number of accidents under spinal anesthesia has been so great and so fatal that it has been largely given up by American surgeons. The results with sacral anesthesia have been so spectacular in a recent series of cases

that it seems worth while to discuss the method in some detail.

F. Cathelin<sup>31</sup> and Durant (1902) used sacral anesthesia for the purpose of treating grave neuralgias, sexual neuroses, and incontinence of urine. The former first used plain water, salt solution and later added cocaine, novocaine, codeine or morphine. By this method Cathelin reported 49 per cent of the cases of incontinence of urine cured: 35 per cent materially benefited and 4 per cent failures. He failed in his attempts to completely anesthetize the sacral nerves in humans but was successful in dogs.

A. Lowen<sup>32</sup> used 20 to 25 c.c. of 1.5 to 2 per cent novocaine and placed the patient in a sitting posture for some minutes after injection with the idea of retaining the solution in the lower end of the vertebral canal. O. Gros<sup>33</sup> recommended the addition of sodium bicarbonate which he states permits the solution to readily penetrate the nerve sheaths. Strauss prepares a solution by the addition of sodium sulphate which he maintains prevents the decomposition of adrenalin, which he also uses. Hertzler recommends the uses of quinine and urea using 60 to 90 c.c. of 0.6 per cent solution. B. Lewis and L. Bartles<sup>34</sup> reported 48 successful cystoscopies out of 68 attempted and D. R. Pickens<sup>35</sup> reported 81 out of 100 attempted.

Splendid work on this subject has been done by Thompson of Galveston who follows the method described by M. L. Harris.<sup>36</sup> Albert J. Scholl, Jr.<sup>37</sup> used sacral anesthesia successfully in 140 cystoscopies out of 150 in which it was used. He used the method recommended by Labat.

The patients upon whom this type of anesthesia was first used by us were all cases in extremely grave condition.

All cases have been entirely successful except 6. In one of the latter, a seminal vesiculectomy, it was necessary to give a few whiffs of ether during the last five minutes of the operation. In another, that of a man of eighty-six years of age upon whom a perineal prostatectomy

was performed, a little gas or ether should have been used for about the same length of time. A third case was only moderately uncomfortable.

*Untoward Symptoms.* Two cases have had short periods of excitement. One had spasmodic contractions of the legs lasting about one minute. Two others became flushed and somewhat confused temporarily. Most of the cases have an increase in pulse rate and slight increase in blood pressure which lasts throughout the operation.

The untoward symptoms in our cases appeared immediately after the injection was given into the sacral canal and caffeine is always held ready for use in case a collapse occurs.

E. Zweifel<sup>38</sup> reported a death from cardiac and respiratory paralysis due to the injection of 0.8 gm. of novocaine into the dural space. His needle had penetrated the dural sac. B. Kronig<sup>39</sup> reported a case in which the novocaine was injected into the sacral vein. This was followed by a partial respiratory paralysis.

*Preoperative Preparation.* When first seen the patient suffering from residual urine should have his bladder partly refilled with boric acid solution or sterile water whenever catheterized. The amount replaced can be reduced gradually if the patient shows no toxic signs from this procedure. This is called "decompression" and is of vast importance in the prevention of uremia from the complete emptying of an overdistended bladder.

Following the period of decompression it is the practice of the author to do a suprapubic cystostomy for drainage, using a suction apparatus which drains the bladder by means of the double suction tube devised by Kenyon of the New York Hospital and recently modified by Harrah.

The indwelling catheter method of drainage has many objections. The intrusion of a foreign body through the urethra prevents the proper drainage of the fluid from the prostatic tubules and causes additional congestion of the prostate gland.

There is sufficient absorption from the prostatic urethra to keep the patient a little below par at all times.

The suprapubic drainage under suction seems to be the ideal method of procedure as a preliminary to operations on the prostate.

It is an efficient method. The patient keeps dry, clean and odorless. Old men are very much like babies in that if they are dry, clean and comfortable they will thrive but if they are wet, odoriferous and uncomfortable, they, like babies, wilt and do not progress favorably.

By this efficient method of drainage the edema of the prostate is reduced, absorption does not occur and at the time of operation the hemorrhage is considerably reduced. By using a satisfactory binder the patient may sit up on his fourth postoperative day.

Vaccination of the patient by the organisms carried in his bladder occurs at the time of cystostomy. Thus we see that the shock of the prostatectomy is divided into two parts. Indeed the patient is usually more uncomfortable after the first operation than he is after the second.

The important thing about the length of time to be devoted to preliminary drainage is to have no set time for it. By a succession of blood chemical and phenolsulphonephthalein tests one determines when the patient has reached his maximum of renal efficiency. If at the same time the patient feels well and is anxious to proceed, the prostatectomy is then undertaken. One must continually bear in mind that we are dealing with human beings and regardless of the excellence of laboratory tests, if the patient is weak, decrepit or even has a headache it is wise to wait until he, like a well-trained athlete, is "raring to go." Also like athletes, patients waiting around a hospital may go "stale." This is reflected in the patient's well-being as well as his laboratory tests. Such cases must be postponed until they have entirely resumed a state of well-being. The shortest period

of drainage in our series has been eight days, the longest twenty-four months, while the average length of time is sixteen days.

Due to hemorrhage and infection the patient may have a badly depleted circulatory system. In such cases, transfusion, repeated if necessary, of moderate amounts of blood is particularly helpful.

Purgatives are administered the day before the operation sufficiently early so that the patient may have a good night's sleep. Sodium bicarbonate is administered in small doses for a period of two days before operation. Fluids are taken up to, during and immediately after operation so there is no dehydration of the patient.

*Operation.* The most important feature of an operation on the prostate gland is proper preliminary drainage. Next in importance is the anesthesia used and of least importance is the route by which one removes the gland.

General anesthesia should be avoided because it elevates blood pressure and hence there is more hemorrhage during operation. As soon as the patient recovers consciousness he has the pain caused by a fresh incision. These two factors, pain and increased hemorrhage, explain why eight times as many patients went into shock or bordered on it when we were using general anesthesia, than we see now.

The administration of sacral and parasacral anesthesia has been thoroughly described by us elsewhere. The method is easily and almost painlessly applied and has been used on many cases with almost no accidents. Its advantages are many. It is possible to get perfect anesthesia for perineal prostatectomy in 95 per cent of the cases, the remaining 5 per cent require slight reinforcement in some manner. Often the smelling of a little essence of orange or a few drops of ether sprinkled on a piece of gauze are sufficient to accomplish the desired results.

As far as one is able to estimate there is about  $\frac{1}{10}$  the amount of bleeding as

compared to the same operation under general anesthesia. The anesthesia persists for a period of six to eight hours after injection to a certain degree and for two hours for purpose of operation. This fact prevents postoperative pain to a large degree. Thus the main elements which go to make surgical shock are eliminated. Water is imbibed throughout, thus preventing dehydration.

The operation which we prefer is a modification of Young's perineal operation. The splendid tractor devised by Crowell is first passed into the bladder through the urethra. Its blades are then opened. After making a semilunar incision through the skin the two spaces on each side of the central structures are opened by sharp and blunt dissection. The central tendon of the perineal muscles are then incised *behind* the point where the lateral perineal muscles join it. This allows the central structures to be pulled upward with the bulb and lateral perineal muscles. A Kocher clamp is fixed to the posterior part of the central tendon and held in the left hand for the purpose of traction. The index finger of the left hand is inserted into the rectum and the hand covered with a towel. The dissection is carried deeper and the important reflection of the levator ani called the rectourethralis, attaching the rectum to the urethra at the apex of the prostate, is then incised. The levator ani is then dissected from the posterior surface of the prostate which is recognized by the glistening fascia of Denonvillier which covers its posterior surface. It is thus noted that not only has the posterior urethra not been opened but often it is not even seen, which is an extremely important point in the prevention of incontinence. The left index finger is now removed from the rectum and the glove changed, a posterior retractor being placed in position.

The prostate is now opened by making an inverted v slit in its posterior surface, the apex of the incision reaching the exact apex of the prostate and being carried



down to the urethra itself. When this flap is drawn back the verumontanum is seen and a transverse incision is made in front of it. This is deepened by blunt dissection which separates the middle lobe from the posterior lobe with its dividing fibrous leaflet which carries the ejaculatory ducts through the prostate. This procedure leaves the ejaculatory ducts uninjured and still retaining their normal orifices. These facts account for the low incidence of epididymitis following our procedure.

The enucleation of the gland is now continued by separating the hypertrophied portion presenting from the capsule. The index finger is introduced into the prostatic urethra and the so-called anterior commissure split, being careful not to injure the internal sphincter any more than absolutely necessary. If the internal sphincter is split at the top there is grave danger of tearing into the plexus of Santorini with resulting hemorrhage.

The Lowsley clamp is now used to grasp the hypertrophied structure and the enucleation completed.

The vesical orifice is grasped with an Allis clamp, the Crowell tractor closed and removed and the finger of the operator introduced into the vesical orifice to identify and remove any remaining tags of tissue or a subcervical gland enlargement. Pieces of prostatic tissue as big as a lime are removed with the author's clamp through the vesical orifice without difficulty. Particular attention is paid to the thorough removal of small nodules of prostatic tissue and to tags of fibrous material as well. These half-destroyed tissues will remain as a future menace to the free passage of urine or become necrotic and offer a fertile field for the infection of the entire prostatic cavity.

A Pezer tube, size 26 F., is introduced into the bladder through the urethra and fixed in position by means of adhesive. The vesical orifice and prostatic cavity are now thoroughly packed with vaseline gauze, enough being used so that the bleeding is entirely stopped on the table. The

floor of the pelvis is closed by drawing the two sides of the levator ani muscle together with a catgut suture. The skin is closed with silkworm gut.

*Postoperative Course.* We have had only one death attributable to the anesthesia. In the first series there were 2 cases that could not have been operated upon except by means of sacral anesthesia as they were in no condition to withstand inhalation anesthesia of any sort. In the last series of 19 patients there is one such case. We have felt for sometime that blood pressure observations were much more important in the postoperative tests than any other feature of immediate recovery. It has been a surprise and delight to observe this series of cases. In none of the second series has the blood pressure dropped below 100 mm. Hg. and all of them have shown a tendency to rise at the danger period, about six hours after the operation. We have not found it necessary in any of these cases thus far to give stimulation to the circulatory system either by means of drugs, intravenous infusion of gum-glucose or any other substance.

The general appearance of the patients on the day following operation by this method is suprisingly good and it would seem that the shock to the entire body mechanism is very considerably reduced by avoiding inhalation anesthesia. There have been no late developments such as headache, paralysis or other alarming effects. Thus far our patients seem to improve from the zero postoperative hours (six to ten hours after operation) without interruption.

Postoperatively the prostatectomy patient must be handled and watched over as carefully as any baby. The patient operated upon under sacral anesthesia may take fluids without becoming nauseated, not only immediately after operation, but during the operation as well.

After the operation is over he should be allowed to rest quietly in bed which he will do in almost 100 per cent of the cases, because he remains somewhat under

## PROSTATIC OPERATIONS UNDER REGIONAL ANESTHESIA UP TO JANUARY 1, 1928

James Buchanan Brady Foundation for Urology

Diagnosis	No. of Cases	Average Age	Operation	Type of Anesthesia	Postoperative				Other Complications	Average Length of Postoperative Stay in Hospital	Results			Mortality (Per Cent)
					Good	Medium	Poor	Shock			Cures	Improved	Dead	
Adenomatous hypertrophy of prostate gland.	297	64.47	Perineal prostatectomy	Sacral Parasacral procaine 1 per cent	266	28	3	10	Hemorrhage 6	22.76 days	280	17	5.7	
Carcinoma of the prostate.	33	67.36	Perineal prostatectomy	Sacral Parasacral procaine 1 per cent	23	7	3	None	None	21.5 days	30	3	10.0	
Prostatic abscess.....	40	29.17	Perineal prostatectomy	Sacral Parasacral procaine 1 per cent	40	0	0	None	Epididymitis 2 cases Septicemia	10.83 days	40	0	0	
Tuberculosis of the prostate gland.	2	61	Perineal prostatectomy	Sacral Parasacral procaine 1 per cent	2	0	0	None	None	27.5 days	1	1	0	0
Hodgkins disease of the prostate.	1	32	Suprapubic prostatectomy	Sacral Parasacral and suprapubic block	1			None	None	14 days	1		0	

the influence of the narcotics and anesthesia for hours. He should only be disturbed to administer fluids and to take the blood pressure, which is the most important single test to make in such cases.

If the blood pressure drops unduly and does not rise (premonitory symptoms of shock) gum-glucose solution may be administered after the method described by us in 1921. Transfusion of properly tested blood may be administered in extreme cases. In case the bleeding has stopped, the packing is removed from the prostatic capsule in twenty-four hours, the tube is removed from the bladder on the third day and the patient permitted to sit up in a chair on the fourth day. Man is unquestionably an upright animal and apparently all bodily organs functionate better with the patient sitting in a chair than when he remains in bed. The patient receives a remarkable psychological boost when his feet touch the floor and one cannot help but be impressed by the fact that improvement is marked after he is allowed out of bed.

Upon revealing the results of operations upon the prostate one is forcibly impressed by the fact that age is no contraindication to operation whatever. In our series of cases there were 26 men over eighty years of age, of whom all except one lived for varying, considerable lengths of time after prostatectomy, and died of some other cause in no way connected with the operation.

Almost every case that recovers from a perineal prostatectomy is able to return to his customary duties. Provided both sphincters are not lacerated beyond repair there is never a resulting incontinence; apparently either sphincter may be totally obliterated, provided the other remains intact, without incontinence. Persistent fistula never results if the perineum is reconstructed by one stitch drawing the two parts of the levator ani together. Frequently patients whose prostates have been removed are able to enjoy sexual intercourse. Occasionally the ejaculated mass goes back into the bladder instead of being projected from the urethra.

The bladder, usually infected before operation, almost always afterwards will clear up under appropriate treatment provided the operation has been successful, and there is no residual urine.

*Conclusion.* In conclusion it is appropriate to state that the most important thing about an operation for the removal of an enlarged prostate is the preoperative preparation which is summed up in the one word "drainage." Next in importance is the choice of anesthetic. This should not be an inhalation anesthesia if it is possible to avoid it.

#### CARCINOMA OF THE PROSTATE

It will be seen by referring to the accompanying chart that there were 33 cases of carcinomatous prostate operated upon with a mortality rate of 10 per cent.

It is our practice to remove carcinomatous prostates which cause residual urine because even the most enthusiastic supporters of radium treatment admit that the application of radium has no beneficial effect on the relief of obstruction. Therefore we remove the prostate by the methods here described and as soon as the patient recovers from the immediate effects of the operation radium is administered to the prostatic bed in the form of emanation seeds or the element itself is applied. In our experience it is noted that there is little liability of the growth returning at the site of the prostate. The patients usually live from two and one-half to three and one-half years, ultimately dying of metastasis.

This method of treating carcinoma is well worth while as the patient does not die of uremia and does not undergo the distressful urinary symptoms which he otherwise would surely have.

#### PROSTATIC ABSCESES

Our series shows 40 cases of prostatic abscess operated upon by the perineal route under regional anesthesia. In a study made some years ago when the author had the honor of serving on Dr. Keyes' staff

at Bellevue, parallel series of cases were operated upon by the perineal and suprapubic route. It was found that the average stay in the hospital after transvesical prostatic drainage for abscess was 31 days, while by the perineal route the average postoperative stay was 16.9 days.

The average of our cases was 29.17 years. There were 2 cases of epididymitis and one case of septicemia following operation. The latter case recovered after repeated blood transfusions. The average postoperative stay was 10.83 days. None of these cases died.

#### TUBERCULOSIS OF THE PROSTATE

Two cases of tuberculosis of the prostate were operated upon. A mistake in diagnosis was made in each case. One aged fifty-three showed prostatic shadows in the x-ray and the palpating finger detected a grating. The provisional diagnosis was prostatic calculi. Operation revealed what was considered a calcified tuberculous abscess of the prostate. This diagnosis was confirmed by the pathologist.

The other patient, aged sixty-nine years, had a prostate three times the usual size which caused a residual of 5 vi. It was removed in the customary manner. The pathological report showed it to be "hyperthrophia fibroadenomatosa prostates and caseous tuberculosis of the prostate gland."

These patients made uneventful recoveries.

#### CASE OF ENLARGEMENT OF THE PROSTATE GLAND SHOWING SOME OF THE CHARACTERISTICS OF HODGKIN'S DISEASE

Our case at the James Buchanan Brady Foundation for Urology of the New York Hospital presented a definite lymphocytosis, a moderate anemia of the chlorotic type, an enlargement of the chain of inguinal lymph nodes on each side, a loss of weight and strength and an impaired appetite and the general appearance of a tuberculous individual, all associated with marked enlargement of the prostate, acute

retention and urinary symptoms of only three months' duration.

The case presented the following history:

A single man, aged thirty-two years, was admitted to the Medical Division of Dr. W. R. Williams on December 7, 1926 and transferred to the Urological Division, December 11, 1926. He stated that his father died at the age of fifty-nine, from cancer of the liver. He was ill fifteen months. His mother died at the age of twenty-eight, from pulmonary tuberculosis. She was ill one and one-half years. He has one brother and two sisters, all living and well. He denies lues and gonorrhea by name and symptoms. He had mumps ten years ago. Pneumonia fourteen years ago. Until four years ago he was a chronic drinker. Since that time he has never touched liquor.

About three months before admission to the hospital he developed a moderate frequency of urination by day and by night. As time progressed this condition grew worse and was associated with painful and difficult urination. He noticed no pus or blood in his urine. His sexual powers were undisturbed. Three days before admission to the hospital he was unable to void except with utmost pain and difficulty. He finally developed acute retention and was brought to the hospital in an ambulance. His bladder was decompressed gradually by means of a retention catheter. He was fairly well nourished and seemed in moderately good health, although he stated that he had lost 20 pounds during the past six months and during the past three months he had grown progressively weaker, but had not been confined to his bed. He had no cough. His bowels moved regularly. His appetite was impaired. He did not suffer from insomnia but grew dyspneic on slight exertion.

His general physical examination was negative except for moderate bilateral enlargement of the inguinal lymph nodes and a small fibroma on the inner aspect of the left thigh. His liver and spleen were not palpable. Chest negative. The lower poles of both kidneys could be felt as well as the distended bladder. Rectal examination revealed slight hemorrhoids. The sphincter tone was good, the prostate was about twice the usual size, it was hard on the right side but did not have the boardlike rigidity of carcinoma. The left side of the prostate seemed normal in consistency

and not fixed in position by adhesions. The left seminal vesicle was palpable but not enlarged. The right was barely palpable. The impression gained at that time was that the patient was suffering from enlargement of the prostate with retention of urine.

Cystoscopy under caudal anesthesia revealed a diffusely reddened vesical fundus. Ureteral orifices were not distinctly seen. The vesical orifice was most interesting in that it showed a tremendous intrusion of the subcervical group on its floor.

Blood urea nitrogen 17 mg. per 100 c.c. Blood sugar 0.112 per cent. Carbon-dioxide combining power of the blood plasma 56 volumes per cent. The phenolsulphonphthalein test showed a secretion of 60 per cent in two hours at one examination and 75 per cent at another.

Blood Wassermann reaction was negative with both antigens on two occasions. Cultures from bladder urine showed *B. coli communis* and *Staphylococcus albus*.

Urine examination: Reaction acid, Specific gravity 1018. Trace of albumin, no sugar, no acetone.

Microscopic examination showed many red blood cells, few white blood cells, occasional epithelial cells, no crystals, no casts.

Complete blood was made on two occasions as follows:

	December 8, 1926	January 9, 1927
Red cells.....	5,112,000	4,815,000
Hemoglobin, per cent.....	93	88
Color index.....	0.91	0.92
White cells.....	8,600	7,400
Polynuclear neutrophils, per cent.....	54	46
Lymphocytes, per cent.....	38	44
Large non-nuclear, per cent.. (Transitional)	6	7
Eosinophiles, per cent.....	2	3

Blood pressure on entrance: 114 systolic, 62 diastolic.

X-rays of the genitourinary tract revealed both kidney shadows large in size and low in position. There was no shadow indicative of stone in the urinary tract.

The patient was subjected to a suprapubic cystostomy under local anesthesia. Examination of the interior of the bladder revealed a mass extending from the floor of the bladder neck about the size of a walnut which was rather firm in consistency. A specimen was taken from this tumor-like projection and sent to the laboratory for examination. The bladder

was drained by suprapubic suction for a period of fourteen days, after which time the prostate was removed suprapubically under sacral and parasacral anesthesia. It was interesting to note that this growth had greatly increased in size since the first operation. The site whence the original specimen had been removed had grown out in a very irregular manner so that it represented a cauliflower. Malignancy was suspected. The prostate was removed completely except for one point on the left lateral aspect where it was densely adherent and apparently infiltrated into the capsule of the prostate. The patient made an uneventful recovery and was discharged from the hospital fourteen days after prostatectomy with good urinary control and wound completely healed.

The prostate was examined by Doctors Elser and Semsroth of the New York Hospital. The report is as follows:

The specimen consists of several irregular shaped pieces of tough tissue measuring from 1 to about 4 cm. in diameter. The outer surface appears yellowish white, somewhat translucent, opaque yellowish strands are seen running through a whitish matrix. The gross picture is not that of a carcinoma nor does it show evidence of a normal prostatic tissue.

The accompanying microscopic slide shows the picture of a chronic inflammatory process. The granulomatous new-formed tissue is rich in plasma cells and contains mononuclear giant cells of the Sternberg type.

The condition is inflammatory (a granuloma). Plasma cells and Sternberg giant cells point to Hodgkin's disease. The latter malignant lymphogranulomatosis starts in lymphoid structures and as a rule spreads to other lymphoid structures, leading to a general lymph node enlargement, always fatal. The localization, however, of the process at the neck of the bladder is most unusual in Hodgkin's disease.

An inguinal lymph node was removed and examined. Microscopic sections showed simple chronic lymphadenitis with no evidence of a granulomatous process like that seen in Hodgkin's lymphogranulomatosis.

The small tumor on the inner aspect of the left thigh showed on microscopic sections the picture of a fibroma durum covered by stratified squamous epithelium.

*Summary of Findings.* It is unusual to find complete retention of urine in a man

aged thirty-two years due to a solid tumefaction of the prostate gland.

The gradual onset of the symptoms exhibited by the patient is similar to those described by most of adenomatous enlargements of the prostate in old men. The usual frequent and painful urination culminated in complete retention of urine rather more rapidly than most cases of adenoma.

There was a rapid increase in the size of the intrusion in the two weeks' interval between the suprapubic cystosomy, at which time a piece of tissue was removed from the tumor for diagnosis, and the actual removal of the mass with the prostate. The spot whence the specimen was removed showed a cauliflower overgrowth such as one sees in almost any malignant growth under similar conditions.

Upon removal it was noticed that it enucleated quite freely except at one point on the left lateral aspect where it was densely adherent and had apparently infiltrated into the capsule of the prostate. The impression of the author at the time of operation was that the case was one of malignancy of the prostate.

The specimens removed when examined microscopically showed granulomatous new-formed tissue rich in plasma cells containing mononuclear giant cells of the Sternberg type.

The examination of the enlarged inguinal lymph nodes showed simple chronic lymphadenitis with no evidence of a granulomatous process like that seen in Hodgkin's lymphogranulomatosis.

#### CONCLUSIONS

It is concluded from observations of a large series of cases (373) that:

1. The most important item in the care of a case suffering from prostatic disease is a suitable drainage until the patient reaches his maximum of renal efficiency.

2. The author believes that the best kind of preliminary drainage is by means of suprapubic double tube suction, because such a procedure diminishes the

edema of the prostate and thus is a factor in reducing bleeding.

3. Sacral or parasacral is the most suitable type of anesthesia for prostatectomy. Its advantages are:

a. It is efficient.

b. It allows the patient to take fluids up to, during and immediately after operation.

c. The bleeding is very much less than it is with any kind of general anesthesia.

d. Anesthesia persists for several hours after operation making the administration of morphine with its attendant bowel stasis unnecessary in many instances.

4. Perineal prostatectomy is preferred because there does not seem to be so much shock as noted in the suprapubic operation. The postoperative drainage is accomplished by means of an urethral catheter which allows both the perineal and suprapubic wounds to close.

5. The average postoperative stay in the hospital has been reduced to 22.76 days.

6. Almost 10 per cent of the prostates operated upon were carcinomatous.

7. The mortality for the adenomatous cases was 5.7 per cent while there were 3 deaths out of 33 cases of carcinoma.

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## DISCUSSION

DR. JOHN MORRISSEY: Dr. Lowsley's enthusiastic and very interesting presentation of the principles which he has advocated for the past six year is very impressive but the fact that it is not entirely convincing and fully accepted is borne out by the very limited number of perineal prostatectomies which are being done in the hospitals of New York City. Some three years ago I attempted to make a tabulation in this regard and less than 30 cases were discovered in a total of 14 hospitals during the preceding twelve months. It would seem, therefore, that his principles, those of Dr. Young and other forceful advocates of the perineal route, do not fully obtain and for that reason, therefore, my own experience in this regard may not be altogether uninteresting.

In the past six and one-half years I have operated on some 275 cases of enlarged prostates and some 200 of these have been perineal operations. I must say that the greatest objection to the perineal route is the dribbling, lack of control incontinence that follows the operation. Dr. Young and others consistently deny that incontinence or any interference with control is a complication of a perineal procedure and yet you can meet any number of urologists who have seen numerous cases of disturbed control following perineal prostatectomy. The very fact that numerous modifications of the original Young operation have been devised to meet this complication would seem sufficient evidence that we have a definite problem to deal with. As a matter of fact, I have devised an operation myself which attempts to preserve the external sphincter, thereby overcoming this difficulty.

My feeling regarding dribbling is that it concerns solely the mechanics of the bladder in that in enlargement of the prostate you have a dilatation of the internal sphincter. This is generally functionless, and in the perineal operation it is practically impossible to avoid damaging the external sphincter. Often times this damage is not done until the prostate is pulled out from its bed when some fibers of the sphincter are torn. The tear may be only microscopic and yet it is sufficient to interfere with adequate control, particularly in the presence of a useless internal sphincter. After the wound is healed, even though the sphincter be torn, there are scars formed which provide a certain

amount of tension and assistance in enabling the patient to retain his urine. As this scar is gradually absorbed, however, the sphincter relaxes and in two years it may be fully determined whether or not the patient has or has not control which is satisfactory to him.

The urologists at Mayo Clinic point with certainty to numerous cases where this dribbling has not been observed until after the two-year period. It is my practice to thoroughly drain the prostatic bed and space inside the levators not only with a gauze drain but with rubber tubes and this is kept up for some ten days following the removal of the packing. This prevents a scar formation and you are able early in the convalescence to train the patient in developing control in the event that it is lacking at first. In my operation the prostate is removed around the urethra and in the capsule incisions they are carried to either side of the center rather than into the urethra themselves. There are numerous other outstanding features of perineal prostatectomy which are unparalleled in the consideration of the advisability of methods. First, as regards bleeding. It is a complication never met with. I have operated on some 125 cases where it has not been required to tie a single vessel. I avoid cutting the levator muscles, lifting them from the prostatic capsule, and in placing a deep suture through these muscles to close the wound you practically control the entire amount of bleeding met with. A further point might be made with regard to the safety of this method in patients over seventy-five years of age. I recently operated on a man eighty-nine years of age. As a matter of fact, he left the hospital today, exactly two weeks after his prostate had been removed.

As regards mortality. I do not feel there is a great degree of this. I simply insist that I feel much more certain as to the outcome in the perineal cases. You must take my word as to the ease of dressings and postoperative care following perineal prostatectomy compared with suprapubic prostatectomy. Here the judgment of one who has done an equal number of both must be accepted. It is interesting to note also the relative seriousness of complications. For example, a epididymitis after a perineal prostatectomy is generally much less severe than one following suprapubic prostatectomy. Let me bespeak a more earnest consideration of some of the advantages that this perineal prostatectomy offers and

I am sure if the procedure is utilized more frequently you will be amazed at the satisfactory results which will be obtained.

DR. HOWARD JECK: I happen to belong to the majority who favor the suprapubic method, but I agree with Dr. Lowsley in two of the points that he brought out namely, the advantages to be derived from decompression in those cases with a large amount of residual urine and the suprapubic method of preliminary drainage. I do not think the suprapubic route can be improved upon as far as preliminary drainage is concerned.

As for the control of hemorrhage, in my experience I cannot recall a case where the hemorrhage has not been satisfactorily controlled by the Pilcher bag. I have seen operators tie off bleeding vessels as Dr. Lowsley has described and think it is a beautiful procedure, yet I cannot but feel that, from my experience, it is quite unnecessary. In most instances the hemorrhage is not alarming and where it appears so it is satisfactorily controlled by the Pilcher bag.

I should like to ask a couple of questions. In the first place, has Dr. Lowsley encountered many cases of hypertrophy of the trigone with a bas fond behind the interureteric ridge, and if so, how does he handle the situation? Secondly, how many cases of incontinence has he seen after the perineal operation?

DR. MEREDITH CAMPBELL: I would like to ask a question about the method of decompression employed, that is the emptying of the bladder and partial refilling. I would like to know if these patients have shown any evidence of renal shock following this procedure. At Bellevue Hospital some ten years ago we made observations in a series of 25 cases admitted in acute retention because of prostatic hypertrophy. In these cases the bladder was emptied ounce by ounce, the bladder pressure being taken with the withdrawal of each ounce. I found that in all cases when 4 ounces had been withdrawn the bladder pressure was reduced 50 per cent. In some instances with the withdrawal of but 2 ounces the bladder pressure was reduced one-half. We felt that this represented the major portion of the cause of the renal shock associated with rapid decompression or evacuation. I wish to know if withdrawing all the urine and refilling with one-half the original amount is succeeded by any evidence of renal failure clinically.

DR. LOWSLEY, *closing*: Dr. Morrissey spoke

about the scar tissue surrounding the healed operation. That is very important. I did not say much about the postoperative treatment, but I think that every patient operated on should have a regular course of dilatation following it. We have here a circular wound, and all circular scar tissue will contract. I have seen a case who had not been dilated, who, in one year's time after his operation had a contraction to a pin point size of his vesical orifice, because he did not follow the advice which must have been given him to have himself dilated after operation. One year later he was passing practically all his urine through his suprapubic fistula, which had never healed. He was cured by an external urethrotomy and dilatation of the vesical orifice, because we could not enter the urethra:

Dr. Jeck asked about the formation of a bar (hypertrophied trigone). I have seen two or three cases of that sort, and practiced the procedure laid down by Hinman. I had one case recover with very excellent results. I excised the interureteric ridge and also cut Bell's muscle at the edge of the trigonum vesicae.

Incontinence: While practicing the old procedure that Young devised and which lasted for fifteen years without any modification (then six or seven modifications were made in two years) we used to have 10 per cent of cases with incontinence for long periods of time. We found that it was due to the injury of both sphincters; that is why we make such a point of not interfering with the structures around the external sphincter; we try to leave it undamaged. Since adopting this method we have had only one case of persistent incontinence which has caused the man all sorts of trouble. That is the only case I know of. We have had several patients who have had some relaxation, would lose a drop or two when they cough or sneeze . . . but the average case will have control in two weeks to two months.

Replying to Dr. Campbell's remarks about decompression: I do not think we have had a single patient develop uremia due to our method of decompression. The method used by Hamer, to put a reservoir of fluid at a certain height above the bladder and then lower it a little each day, is a very good method too; but as far as I know we have not put any one into uremia by this very simple device of putting back half of the amount of fluid and allowing the bladder to fill up.



# POSTOPERATIVE PHYSIOLOGICAL STUDIES IN A CASE OF TRAUMATIC RUPTURE OF THE LIVER

WITH RECOVERY\*

R. B. McKNIGHT, M.D., F.A.C.S.

CHARLOTTE, N. C.

THE liver is probably the most frequently injured viscus in the abdomen in abdominal injuries. Owing to its friable nature, size and anatomical position, concussion may cause a lesion of varying degrees of severity, slight and inconsequential or extremely grave. Sudden blows over the abdominal wall, particularly if they involve much surface, are prone to cause injury to this organ.<sup>7</sup> It has a distinct tendency to split or crack in a more or less stellate manner, with massive hemorrhage and escape of bile.<sup>8</sup> When Glisson's capsule is badly lacerated, the amount of hemorrhage is necessarily greater than when the trauma is limited chiefly to the liver parenchyma.<sup>4</sup> Frequently other abdominal or thoracic organs or the diaphragm are injured also, thus producing more or less serious complications which may mask symptoms referable to an injured liver.

The causes of traumatic rupture are, of course, varied; gunshot wounds, stabs with sharp instruments and crushing injuries with or without a break in the skin. Stabs and gunshot wounds usually recover following immediate operation, provided there is not too much destruction of tissue. Rupture due to sharp concussion causes a much higher mortality. Ashhurst, quoting Boljarski, places the mortality after operation at 75 to 80 per cent.<sup>1</sup>

The symptoms of subcutaneous traumatic rupture of the liver are well outlined by Graham, who reported 11 cases, one his own.<sup>6</sup> There are several points I wish to lay some stress upon, however. (1) Intermittent severe pain radiating in various directions, depending on the site of the rupture. If the convex portion of the right lobe is injured, pain is referred

to the right scapular region as in cholecytic disease; if the concave portion is involved the pain is referred to the waist line anteriorly. Steiger<sup>11</sup> states: "A symptom usually present is pain radiating into the right shoulder as is commonly noticed in gall-bladder disease. This is real assistance in diagnosis of hepatic injury."

(2) Shock is usually present, although various observers have reported it at times almost absent. (3) Many have noticed a slow pulse. Erderly<sup>5</sup> operated on a fatal case of liver rupture in a boy thirteen years of age with a perfectly healthy heart, who had a pulse rate of 60 in spite of severe intra-abdominal hemorrhage. He concluded that bradycardia cannot be considered evidence against intra-abdominal hemorrhage when other symptoms speak for it. Indeed, some surgeons have considered a slow pulse as indicative of liver injury. Orth<sup>9</sup> reported a case in a twenty-seven year old man who had a pulse rate of 54 two hours after the accident. He stressed the fact that marked tension of the abdominal wall and bradycardia were the foremost symptoms in the pathological picture. Experimentally he was able to produce bradycardia in dogs after hepatic injury, but only when there was a profuse discharge of blood and bile into the free peritoneal cavity. (4) Board-like hardness and exquisite tenderness occur over the involved area as a rule. (5) There is a sharp rise in the leucocyte count, whereas the erythrocyte count and hemoglobin may be slower in dropping. (6) In severe injury jaundice seldom appears before the third or fourth day, and it may not appear at all.

Treatment consists in early operation, utilizing whatever methods are deemed

\* Submitted for publication September 9, 1929.

best on sound surgical judgment to control bleeding in the individual case. Transfusions are, of course, indicated, and probably

Clinic has found life incompatible with a minute amount of liver tissue left free in the abdomen.

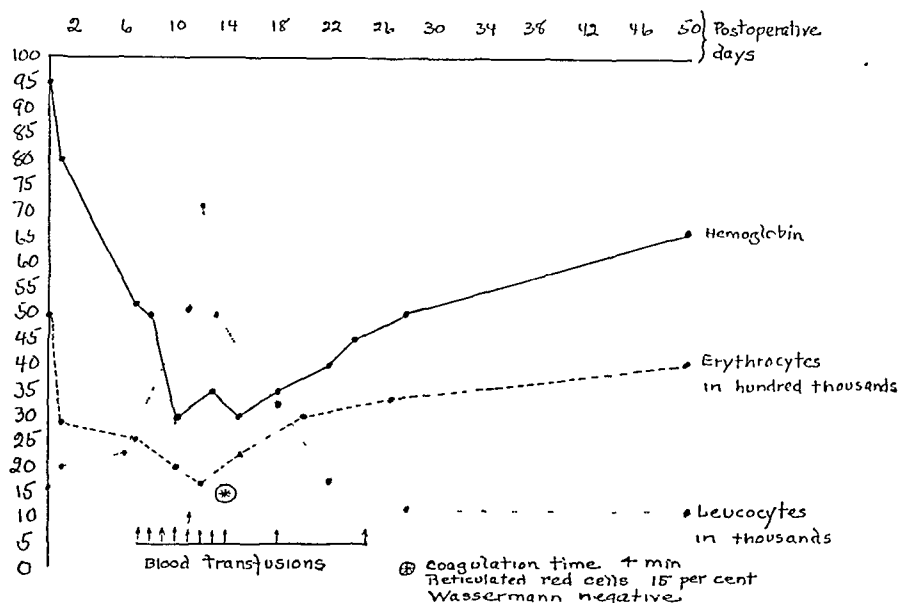


FIG. 1. Hemoglobin, red cells and white cells.

the earlier begun the better. White<sup>12</sup> suggests autotransfusion of blood in the peritoneal cavity when it cannot be obtained from other sources. He has reported such a case with recovery. As an emergency procedure this is justifiable. However, the presence of extravasated bile and the possibility of the contents of a ruptured hollow viscus mixed with the blood in the abdominal cavity, should make this a procedure to be done only after very careful abdominal exploration. Various supportive measures and careful postoperative observations both clinical and laboratory, with prompt attention to whatever complication may arise, are necessary.

Prognosis seems to depend largely on several factors: (1) the amount of destruction of liver tissue; (2) the escape of bile into the peritoneal cavity, which is quite liable to be a contributing cause to a paralytic ileus; (3) the presence or absence of injury to structures other than the liver, and (4) careful attention to any postoperative complications which might arise. It is well to remember that Mann of the Mayo

#### CASE REPORT

A young white man, aged nineteen, was injured in an automobile accident about 8:30 the evening of April 29, 1928. He was sitting in the rumble seat of a car which collided head-on with an on-coming car, throwing him with violent force against the back of the seat in front. He struck his right chest and right upper abdomen and at once experienced severe pain in these areas. I saw him in about half an hour after the accident at the Mercy General Hospital. His pulse was 74, temperature 98.4°F. and respirations 26. He complained of pain in three distinct locations: (1) the upper right abdominal quadrant; (2) the right chest wall, and (3) the right scapular region. Examination revealed a well-developed young man in moderate shock. There was an area in the upper right abdominal quadrant board-like in hardness and exquisitely tender, a spot in the right anterior axillary line about the seventh or eighth rib was quite painful on palpation and there was a slight laceration of the face which was of no consequence. Urinalysis was entirely negative. The blood count showed a hemoglobin of 90 per cent, 5 million red cells, and 16,000 white cells. Roentgen ray of the chest revealed a fracture of the seventh rib

in the anterior right axillary line with perfect approximation of the ends. Two per cent mercurochrome was applied to the laceration

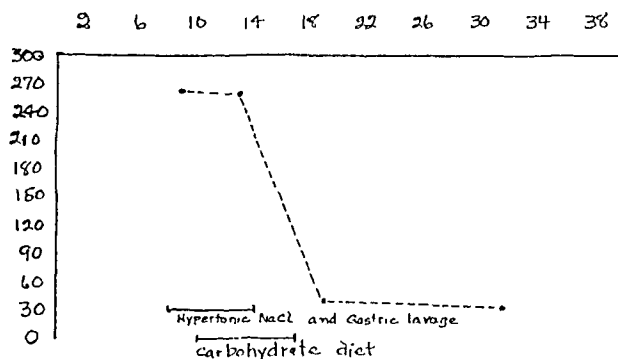


FIG. 2. Blood urea (in milligrams).

on the face; the chest strapped with adhesive and a period of "watchful waiting" assumed in so far as the abdominal condition was concerned. Mild opium narcosis and a hot water bottle to the abdomen were ordered. During the night the pulse went down to 54 (three hours after the accident) and the patient was restless and in pain. At 11:30 P.M. the white count had risen from 16,000 to 20,000

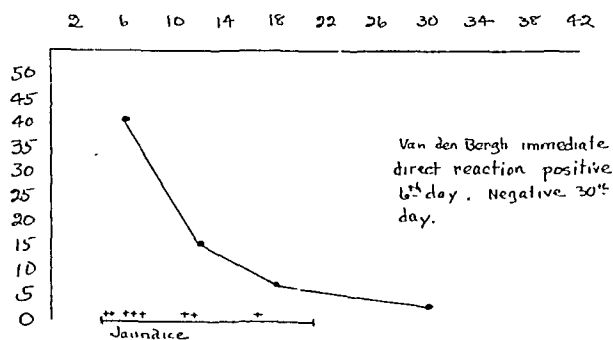


FIG. 3. Icterus index.

The following morning the pulse was 70, temperature 98.4°F. and respirations about 20. Blood pressure was 120/74. The urine showed a faint trace of albumin and was positive for sugar. The white count was still 20,000. Abdominal pain and board-like hardness were more pronounced. I could not make out a fluid wave. About noon the pain became unbearable. I made a tentative diagnosis of ruptured liver 75 per cent, ruptured hollow viscus 15 per cent and ruptured spleen 10 per cent. Before operating, however, I desired consultation in view of what I considered atypical symptoms. The consultant concurred in my diagnosis.

Exploration was performed at 2:30 P.M. April 30, under morphine narcosis and light ether anesthesia. A high right rectus incision

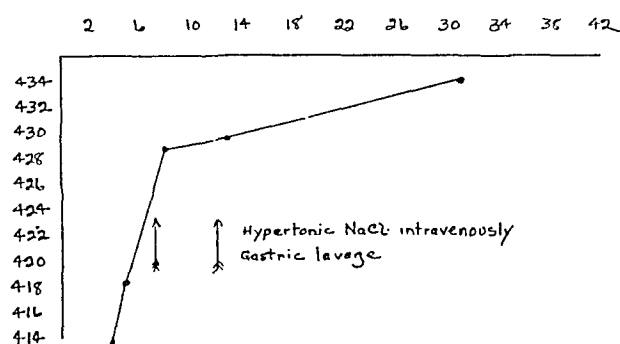


FIG. 4. Blood chlorides.

was made; there was approximately 1000 c.c. of blood, both fresh and clotted, in the abdominal cavity, this was removed with sponges and the aspirator as thoroughly as possible; the intestines were markedly bile stained; the gall bladder was completely collapsed, but no injury to that viscus or the ducts could be found; the spleen, stomach, duodenum, intestines, pancreas and kidneys were negative for injury; blood was seen trickling down the

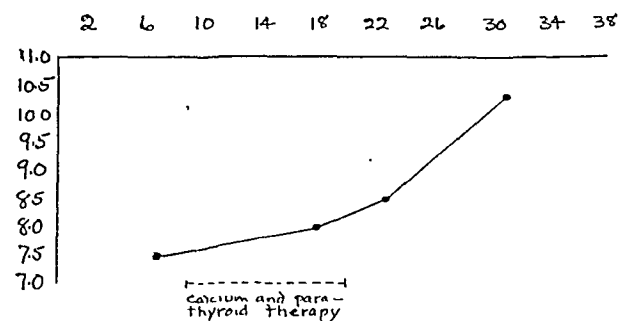


FIG. 5. Blood calcium.

anterior surface of the liver, but no rupture was visible; the exploring hand encountered a large rent far up on the superior surface of the dome of the right lobe of the liver; this rupture easily admitted four fingers, which went down into liver tissue against no resistance as far as they could be thrust in a bent exploring position; there was no injury to the diaphragm. Suturing of this wound was absolutely out of the question. The cavity and area between the dome and the diaphragm were packed with about 16 feet of uterine packing which was brought out of the upper pole of the abdominal incision through a Penrose drain. I made a rapid closure completing the operation in about thirty minutes.

The patient left the operating table in fair condition only. The usual immediate postoperative supportive measures were instituted.

*Postoperative Course.* Reaction from the operation was uneventful. For five or six days his condition remained satisfactory. On the sixth day his condition became worse; jaundice was markedly increased, the abdomen was somewhat distended, and nausea, which heretofore had been about what one would expect following an ether anesthetization, was more pronounced. The patient looked toxic. For eight days he remained in a critical condition, with symptoms characteristic of a severe toxemia of obstructive origin. At the end of the third postoperative week he was well on his way to recovery.

During the critical stage the observations charted below were made, and treatment was based on their findings as well as on clinical observations. This treatment consisted of daily blood transfusions, hypertonic intravenous saline infusions, gastric lavage, practically a pure carbohydrate diet (inclusive of glucose by rectal drip), calcium and parathyroid therapy and supportive cardiac measures.

#### CLINICAL OBSERVATIONS

##### 1. *Pulse, Temperature and Respirations.*

The pulse dropped to the low reading of 54 in about three hours after the accident in spite of severe intra-abdominal hemorrhage. The highest it went before operation was 80, and then immediately before surgical intervention. The temperature and respirations were about what would be expected throughout his illness, with the exception of the twelfth postoperative day when a subnormal temperature, labored respirations and a mounting pulse rate led me to expect an early death.

2. *Blood Picture.* The hemoglobin dropped to 80 per cent on the day of operation. Six days subsequently it was 52 per cent. Blood transfusions were begun and were given daily, two on the eleventh postoperative day. In spite of nine consecutive transfusions of 500 c.c. each of citrated blood, the hemoglobin dropped steadily to 30 per cent. The red cells dropped accordingly to 1,600,000 while the leucocytes went up to 72,000 with neutrophils over 80 per cent. The fourteenth postoperative day the coagulation time was four minutes and there were 15 per cent of reticulocytes with the red count and hemoglobin at their lowest levels. At no time was

there any appreciable amount of fresh blood on the dressings.

3. *Blood Chemistry.* (a) The blood urea on the eighth postoperative day was 268 mg. per 100 c.c. of blood. Under gastric lavage, hypertonic intravenous saline injections and carbohydrate feedings it dropped to 32 mg. per 100 c.c. in about ten days.

(b) The blood chlorides on the fifth day were 418 mg. per 100 c.c. In a week's time under therapeutic measures outlined it had risen to 430 mg. per 100 c.c.

(c) The blood calcium under calcium and parathyroid therapy rose slowly from 7.5 mg. on the seventh day to 8.5 mg. on the twenty-third day, and finally to 10.4 mg. on the thirtieth day.

(d) The icterus index was 42 the sixth day. With the disappearance of jaundice on about the twenty-second day it had dropped to 5.0. The Van den Burgh test showed an immediate positive direct reaction which became negative in about a month.

4. *Urine.* The urine was entirely normal on admission. The day of operation it showed a trace of sugar and a faint trace the third day. Albumin and granular and hyaline casts promptly appeared and remained fairly constant for three weeks. On dismissal from the hospital, there was a very faint trace of albumin and a rare cast in centrifugalized specimens. Determination of acetone bodies was not done, it is improbable that they were present.

#### DISCUSSION

The physiological significance of the liver assumes great proportions when we realize that it is located between the intestines and the greater circulation. It is difficult to grasp the complicated functions of this important structure. The researches of Mann and his co-workers at the Mayo Clinic have thrown considerable light on its intricate processes.

It is not probable that the high blood urea is evidence of hepatic insufficiency. Taken with the clinical picture and the low blood chlorides it is undoubtedly evidence of gastrointestinal stasis. The cause of this stasis is undoubtedly twofold: first, the trauma in the peritoneal cavity, and, second, the leakage of bile in the

peritoneal cavity was probably sufficient to produce a paralytic ileus.<sup>2</sup> This was overcome by the injection of hypertonic sodium chloride solution and gastric lavage. With the recovery from the condition, as evidenced by renewal of intestinal activity, the blood urea dropped to normal.

The institution of a carbohydrate diet is of direct value in cases of liver injury, although the exact mechanism involved is a matter of speculation at the present time. Bollmann<sup>3</sup> has found that animals with a greatly damaged liver recover much better on a carbohydrate diet than on diets containing proteins.

The appearance and degree of jaundice was checked with the laboratory observations on the bilirubin content of the blood. The behavior of these tests and the picture of clinical icterus was that of a mild obstructive type of jaundice. The gall-bladder was found to be completely collapsed at operation and much bile was being poured out of the wounded liver. This presented a situation somewhat comparable to a case of obstruction. Blood was being destroyed and accordingly the bile was becoming thicker and richer in pigments so that the ducts could not be readily emptied by the secretory pressure of the liver. The secretory pressure of the liver was necessarily decreased due to the shattering of the right lobe and rupture of Glisson's capsule. Consequently bile was dammed back and forced into the lymphatic channels with a resulting icterus.

An interesting feature is the rapid fall in hemoglobin and red cells in spite of nine blood transfusions, the practical absence of any fresh blood on the dressings and the presence of 15 per cent reticulated red cells. The explanation is closely linked with that of the icterus just discussed. Obviously it was a hemolytic sort of an affair, toxic in origin, a hemohepatogenous jaundice. This is usually referred to as a non-obstructive jaundice, which in reality is not a non-obstructive jaundice at all. There is an obstruction which is shifted from the larger ducts to the small bile

radicles. Many, of course, escape, so that there is not a complete obstruction but a partial one.

The cumulation of urea in the blood may have been associated with renal impairment. Kidney disfunction might have been partially due to trauma, gastrointestinal stasis, jaundice, and also to the destruction of blood both from hemorrhage and from that given in transfusions. As the symptoms of toxemia developed, naturally the kidney showed symptoms of damage: heavy traces of albumin and the presence of numerous casts. It is probable that there was no acidosis as evidenced by the low blood chlorides, high urea and the probability of a high  $\text{CO}_2$  combining power. Later the carbohydrate diet would preclude the possibility of an acidosis. The presence of sugar on two occasions early after operation was probably due to shock associated with the accident and the operation. It promptly disappeared.

By the end of the third postoperative week all clinical findings were either normal or rapidly approaching normal. In four months he was back at work, practically recovered from the accident and complications subsequent thereto.

It is interesting to note here that a year subsequently I referred him to Dr. H. C. Shirley of Charlotte for advice as to tonsillectomy. This was performed by him under local anesthesia. Three days after the operation the patient developed a generalized ooze of blood from each fossa, which persisted in spite of entirely normal blood chemistry findings, normal blood coagulation time, normal platelet count and the usual therapeutic measures, until a small blood transfusion was given.<sup>10</sup>

#### SUMMARY AND CONCLUSIONS

The case reported is an excellent one for study in that the only primary lesion of any consequence was that of subcutaneous rupture of the liver. The outstanding clinical features of the case were: (1) board-like hardness in the upper right abdominal quadrant; (2) referred

pain to the right scapular region, and (3) a slow pulse reaching the low count of 54 three hours after the accident in spite of severe intra-abdominal hemorrhage.

Probably the high mortality in crushing injuries of the abdomen, especially those cases in which the liver is ruptured, is influenced to a large extent by the development of a gastrointestinal stasis and resulting toxemia. This stasis may occur as a result of trauma in the peritoneal cavity, or to a leakage of bile into the peritoneal cavity sufficient to produce a paralytic ileus. The case reported and the studies thereon tend to support this idea.

In addition to early diagnosis and proper surgical means for controlling hem-

orrhage, it is essential that complications subsequent to and depending on a gastrointestinal stasis should be anticipated and promptly handled. The use of carbohydrate feeding, hypertonic saline intravenously and gastric lavage is stressed. The attempt on the part of the body to regenerate blood should be assisted by repeated blood transfusions. Observations on the blood chemistry are necessary for proper treatment.

It is well known that the use of spinal anesthesia is very efficacious in the treatment of paralytic ileus; perhaps such an anesthetic would be the anesthetic of choice in these injuries as a possible prophylactic measure.

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# THE LATENT GALL BLADDER\*

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FOR the purposes of this paper the latent gall bladder is considered to be the one whose function is impaired or lost, as distinguished from frank gall-bladder disease easily diagnosed, although it will be necessary to make some reference to the latter. Probably 10 per cent of the adult population have more or less disease of the biliary tract and due to the factor of pregnancy 8 out of 10 of them are women. This especially applies after the age of forty. There are thousands of people today, who in the next ten or twenty years will go to the operating table for the purposes of having a diseased gall bladder removed. Following operation many will die, probably 5 per cent according to the present average statistics.

While little can be said for the tonsils and appendix, something can be said for the gall bladder. It is now definitely known that the gall bladder concentrates the bile to about one-tenth of the amount delivered from the liver. This bile is passed on to the duodenum at the proper time during digestion. The gall bladder also regulates the pressure in the ducts and may have something to do with fat digestion. However, it is well known that one can get along without it, in fact with great improvement in health if it is removed following proper indications. Following cholecystectomy the ducts dilate, the sphincter of Oddi relaxes and digestion seems to go on as well as when the gall bladder was functioning normally. However, the functional importance of this organ compared with its great power for evil is insignificant, indeed. Acute and chronic infection with or without stones, perforation with infection of the ducts, pancreas and liver and occasionally cancer, not to mention it as a source of focal infection in myocarditis, anthritis and other diseases, all of these can be caused

by disease of this organ. It is also the most prolific source of indigestion and dyspepsia in the middle-aged adult. The older the individual when operation becomes necessary the greater the risk and the more widespread the infection, oftentimes resulting in only partial relief from cholecystectomy.

It has been aptly said that the stomach is the loud speaker for almost every organ of the abdomen. This is especially true for the non-functioning or poorly functioning gall bladder. The symptoms are essentially dyspepsia during early digestion, during the period when the stomach is mechanically reducing its contents to chyme and the duodenum is emulsifying the material received with the aid of the rapidly discharged concentrated bile. If the proper amount is not received there is abnormal activity in the duodenum with antiperistalsis and pylorospasm. This is clinically manifested by uncomfortable fullness after meals, belching and sour regurgitations. Occasionally there is pain radiating around to the back. The patient finds that he cannot digest greasy, heavy, acid foods and for relief finds it necessary to exclude many varieties of food to which he has been accustomed. These symptoms will most often occur when meals are large, or much rich, sweet food is taken rapidly, or if the diet includes raw fruits, salads and especially fats. Sometimes they follow unusual nervous fatigue. Another type of individual in whom the gall bladder is at fault but often not suspected is the one with few complaints referred directly to the abdomen but many nervous symptoms and much complaint as to head pains. Diagnosis is difficult and mistakes are apt to occur if all other possible causes are not ruled out in this type.

The woman who has borne children and is now approaching middle age should always be questioned as to pain in the gall-

\* Read before the Los Angeles Surgical Society, March 8, 1929.

bladder region during the latter months of her pregnancies or shortly after. Often infection starts at this time to remain latent for years afterwards until suddenly an acute cholecystitis develops or a typical gallstone colic occurs. Go into any woman's surgical ward in this country and you will find that almost every obese woman in that ward, barring an occasional umbilical hernia or other type of operation, represents a result of gall-bladder infection. She is there for a gall-bladder operation or for the repair of a hernia as the result of one. Incidentally, if we would look over our postoperative results we would find that postoperative hernia or weakened abdominal wall occurs more than occasionally. Obesity goes hand in hand with gall-bladder infections which have usually been latent for years. The infection flares up when the woman is excessively fat, a difficult subject to operate upon and often not a first-class surgical risk.

In the overweight, middle-aged woman coming in with vague digestive complaints do not forget the latent gall bladder. Only yesterday I operated upon one of these patients, forty-nine years old, mother of ten children, and 70 pounds overweight. The history included many years of obscure digestive complaints variously treated as indigestion and dyspepsia. By standing on a stool so as to get into proper position I was able to remove a chronically inflamed gall bladder completely filled with large stones.

Up until four or five years ago the diagnosis of gall-bladder disease depended upon an accurate clinical history and careful physical examination supplemented by positive x-ray findings in possibly 30 per cent of the cases. A high average of correct diagnoses was made in the fairly typical cases as proved by operation. Now, due to the work of Graham and Cole, a new x-ray technic has been developed so that a positive diagnosis of impaired gall-bladder function is possible in the hands of an expert in about 90 per cent of the cases. It must be remembered that this

test is a functional one and does not demonstrate pathology except in a minority of cases, as when gallstone shadows appear. I believe that this is the most remarkable advance in laboratory diagnosis in recent years. This new method has stimulated increased interest in the diagnosis of gall-bladder disease. Failing to fill is by far the most important sign. This is due to the occlusion of the cystic duct or complete lack of function. This, added to a clear-cut clinical history, makes the diagnosis certain in the majority of cases. Other important signs that may be of value are filling defects due to calculi or irregularities of contour due to pericystic adhesions. Interpretations of variations from normal in filling and emptying time give the most errors in the positive films, probably 5 per cent. The negative cholecystogram at present gives about 30 per cent of errors and should be disregarded if the clinical symptoms point definitely to disease of the biliary tract. However, with ill-defined symptoms and a negative x-ray report, surgery should be withheld until all other causes can be eliminated.

What is to be done about the quiescent or latent gall bladder? Should we rush all of these patients to the operating room as soon as we have determined that the gall bladder is not functioning properly, remembering a 5 per cent mortality and a morbidity which includes postoperative adhesions, ventral hernia and occasional injury to the common duct. Moynihan condemns, every gall bladder to excision if, in the presence of inaugural symptoms, the cystographic shadow is absent, its opacity diminished or its appearance delayed. It must be remembered that the more positive the symptoms the better the operative results, especially if pain is a predominant factor. The converse is also true. I believe that the case diagnosed early before the onset of typical symptoms should first be given the benefit of proper medical treatment.

I would like to say a word as to diet: This should be fat free; all meat fats,



cream, butter, oils, yolks of eggs and cheese are omitted or reduced to a minimum. Coarse vegetables are to be avoided or thoroughly cooked and pureed to reduce motor activity. Raw fruits are also excluded from the diet and the caloric intake is cut down to reduce obesity. This reduces the cholesterol content of the bile and the motor demands on the gall bladder are lessened, tending to a condition of physiological rest, during which inflammation subsides. In the early cases this may be all that is required but too much reliance must not be placed on this method. One or more recurrences will generally indicate surgery.

Besides the usual indications for gall-bladder surgery such as repeated gallstone colics, acute cholecystitis (always surgical when the attack has quieted down), cholangitis and common-duct obstructions, the positive indications for surgery should include symptoms such as nausea, gaseous eructations, abdominal distention, headache and indefinite upper abdominal pain if other causes can be ruled out and thorough medical treatment has failed to bring relief. This especially applies to the overweight middle-aged patient. This should be confirmed if possible by positive x-ray evidence especially failure of the gall bladder to fill or demonstration of the presence of stones. In chronic myocarditis or arthritis when all other sources of focal infection have been eliminated, the removal of a latent, infected gall bladder may bring marked improvement.

Before closing may I briefly consider the contraindications to gall-bladder surgery even in the presence of definite pathology? In general they include severe myocarditis, decompensated cardiorenal disease, advanced nephritis, often diabetes and the severe anemias. Avoid surgery in the elderly patient with angina pectoris, the anginal attacks radiating to the ensiform. Mistakes are liable if the x-ray evidence is positive or a so-called silent stone is revealed. In differential diagnosis remember the relations of pain to exertion and the improvement with rest. Some time ago I was called in consultation on a case of this type, the date for operation already having been set. To avoid embarrassment I suggested calling in a heart specialist to see if the patient could stand operation. The operation was postponed and within a month the patient, while up and about, suddenly dropped dead.

In closing I would like to mention one more type of patient with latent or active gall-bladder disease in whom operation while not contraindicated is exceedingly dangerous. This is the fleshy individual with short neck and short abdominal walls. This patient has a flabby heart and a gall bladder situated deep under the costal arch. People of this type take anesthetics badly and they are subject to shock, postoperative pneumonia and nephritis. When operation is done, local anesthesia with the addition of nitrous oxide or ethylene is the anesthetic of choice.



# INJECTION TREATMENT OF VARICOSE VEINS\*

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UNTIL recently, the treatment of varicose veins of the lower extremities has been notoriously unsatisfactory. Surgical removal necessitates hospital confinement, requires a more or less prolonged stay in bed, and is not without its dangers. In addition to all this, unsightly scars often result and recurrences are far from infrequent. Under these circumstances, many surgeons do not urge operation, and many patients, unless positively disabled, prefer to endure their discomforts and disabilities rather than submit to a procedure which holds out a somewhat indefinite promise of success. With the advent of the injection treatment, however, the situation has undergone a decided change for the better.

Although comparatively new in America, the method has been in use in Europe for a number of years. The French, German, Scandinavian, and, to a lesser extent, the English literature is voluminous on the subject, and the procedure is everywhere generally accepted and practiced.

## HISTORICAL

Attempts to produce occlusion of veins by the injection into them of various substances date from 1851, in which year Pravaz introduced his syringe for the injection treatment of aneurysm. However, due principally to the fact that the solutions formerly used were highly caustic, leading to tissue necrosis and sloughing, and not infrequently to death from septicemia and embolism, the method fell into disrepute and was abandoned.

The present method was originated by P. Linser of Tübingen,<sup>1</sup> Germany. While using mercuric chloride intravenously in the treatment of syphilis, he noticed that the vein after repeated injections became sclerosed and obliterated. He thereupon applied this observation in the

treatment of varicose veins, at first making use of mercuric chloride, later changing to the less toxic sodium chloride. Later, the method was popularized in France by Sicard,<sup>2</sup> using first a solution of sodium carbonate, and later one of sodium salicylate. Since then, the employment of the injection treatment has become general throughout Europe.

In the United States widespread adoption of the treatment has been rather slow, owing principally, I believe, to the fear of embolism. *A priori*, this fear would seem to be well founded; practically, however, the danger may be said to be non-existent, for reasons which will be considered later. From a statistical stand-point, there are available many figures demonstrating the innocuousness of the procedure; among the most recent are those of McPheeters and Rice.<sup>3</sup> These investigators collected reports of 53,000 cases treated by the injection method, with a mortality traceable to the injection of 0.0024 per cent. Linser, likewise, states that he has never observed embolism in over 15,000 injections. These figures are unquestioned; they prove that this method of treatment is one of the safest of surgical procedures.

## SOLUTIONS EMPLOYED

Contrary to the belief formerly held, which belief was responsible for the ill-repute into which the treatment fell for a time, strong toxic and coagulant solutions are not necessary for success; consequently, the use of carbolic acid, ferric chloride, tincture of iodine, etc., is no longer practiced nor is it justifiable. The principal substances in use today are sodium chloride, sodium salicylate and various sugars. Mercuric chloride is advocated by some, but its use has been rather limited, due to its toxicity; furthermore it has no outstanding advantages to recommend it. Other

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drugs which have been suggested and utilized to some extent are sodium citrate, sodium bicarbonate, and quinine and urethane.

Sodium chloride is most commonly employed in the form of a 20 per cent solution. In this concentration it is non-toxic, produces a firm clot, and may be used with a very fine needle, which is an advantage. However, great care must be taken to see that none of it escapes into the surrounding tissues; also, the cramps immediately following the injection are frequently very painful and severe.

Sodium salicylate is injected in a 20 to 40 per cent solution. It is likewise capable of causing considerable tissue damage in case of leakage or of injection outside the vein, and is also toxic to a not inconsiderable number of patients.

Various solutions of sugars are in use, particularly in Austria and Germany: for example, 50 per cent solution of dextrose, equal parts of 50 per cent solutions of dextrose and levulose, which constitutes the mixture known as calorose,<sup>4</sup> and 75 per cent solution of invertose, or invert sugar. The latter is the one which I prefer for general use. All of these solutions produce excellent thrombi, are much less toxic to the tissues in case of leakage, and the injection is practically painless. However, not infrequently a patient will be encountered who does not react to them, and other substances must then be used. Another minor disadvantage is that concentrated sugar solutions are thick, necessitating the use of a larger needle; this can largely be obviated, however, by warming the solution.

In a recent paper, Kern and Angle<sup>5</sup> have strongly recommended a mixture of equal parts of 50 per cent dextrose and 30 per cent sodium chloride. They state that following the use of such a mixture, the resulting clot is very firm and tenacious, and that no sloughs are produced if the solution escapes outside the vessel wall. I have had no experience in the use of this mixture.

It should be emphasized that one

cannot confine his treatment to the use of a single solution. The preparations already described all have their advantages and disadvantages; individuals vary in their reactions. If the desired result is not attained by the use of one drug, the operator must be prepared to employ something else. But for general use, as I have just said, in my experience a 75 per cent solution of invertose has proved most satisfactory. A satisfactory sterile solution is readily available, and is furnished in 10 c.c. ampules.

#### ANATOMICAL CHANGES

The changes in the vein, both gross and microscopic, brought about as a result of the injection, have been exhaustively studied by many investigators, and the findings are everywhere in agreement.

The recent experiments of Kern and Angle<sup>5</sup> typify these findings. Using various solutions, injections were made into the jugular veins of 28 dogs, which were killed at varying intervals thereafter, and the veins removed and studied both grossly and microscopically. Although the injections were made in a large vein not far from the heart, in which the blood current is swift, and in which considerable negative pressure exists, it is interesting to observe that none of their dogs died of embolism or showed signs of pulmonary infarction.

They record the observed changes in the excised vein segments as follows:

Specimen 1 (48 hours old): There was considerable inflammatory reaction of the tissues surrounding the vein. The vein was reduced markedly in diameter and appeared collapsed. The wall had a dirty grayish color and felt thickened and hard. On section it contained a very firm red thrombus that was not easily dislodged. There was no fluid blood.

Specimen 2 (1 week old): The vein was lying in a bed of fresh scar tissue and was dissected out with difficulty. It was about one-third its original diameter and felt like a solid cord. On section there was a firm thrombus occluding the distal segment. The thrombus was half red and half white and extended

proximally for an inch; it was a tapering mural thrombus.

The 2 and 4 weeks old specimens showed a progressive reduction in the size of the vein and the thrombus, with the ultimate conversion of both into a fibrous cord.

Thus it is seen that the immediate effect of the injected agent is to give rise to an irritation of the endothelium of the vein, with congestion and cellular proliferation. As a result of this aseptic irritation, or chemical inflammatory process, fibrin is deposited in comparatively large amounts, amounts sufficient to occlude the vein in the usual case, and to cause stoppage of the blood stream through it. This takes place within a short time after the injection has been given. Later changes in the weeks following consist in organization and sclerosis of the deposit. Occasionally, particularly in the larger veins, the occlusion may be incomplete, or it may happen that the fibrinous mass may sometimes become canalized, with reestablishment of the lumen of the vessel. The process is thus essentially an obliterating endangitis.

From this brief description, it is readily apparent that the pathological condition produced differs in several important particulars from that present in the condition ordinarily known as phlebitis. In the first place, the reaction is sterile throughout; furthermore, it is rather sharply localized to a definite segment of the vein, the clot is extremely adherent to the vessel wall, no pain or general edema of the extremity is produced, and the final result is to leave the vein as an atrophied cord.

Phlebitis, on the other hand, is usually the result of an infective process; thus it may, and usually does affect large portions of the vein; it also has a decided tendency to spread, frequently extending from the superficial network to the deep, giving rise to edema. The clot is loose; pain is a constant feature. The end-result is entirely different, the vein remaining hard and bulky, with no tendency to atrophy, and extremely susceptible to further attacks of infection.

Finally, and for us this is a most important distinction, phlebitis may give rise to embolism, while the artificially produced, chemical venitis has positively no tendency so to do. As is shown by the experiments already mentioned, a study of the excised segments of affected veins anatomically confirms this clinical fact. In phlebitis, the thrombus is found to be loose and jelly-like, insecurely anchored to the vessel wall; in venitis, on the other hand, it is hard and firm, and very difficult to separate. Microscopically, in the latter condition, the clot is found to be so intimately attached that it may almost be considered as a part of the vessel itself, which is far from being the case in phlebitis.

#### TECHNIC

For several months past, I have been giving these injections with highly gratifying results. The technic which I employ is as follows:

The usual tests are made to ascertain the competency of the deeper system of veins. With the patient in the standing posture, the leg is carefully examined, and a prominent vein is selected to be injected. A tourniquet is used if necessary to make the veins stand out sufficiently. The skin is washed with alcohol, and the actual site of injection is marked with mercurochrome. This is important, as the veins become less prominent as soon as the leg is elevated. The patient is then placed on a table, lying down, with the head slightly raised. In order to secure a concentrated action of the solution on the inner wall of the vein, it is necessary to occlude for a time the segment of the vessel into which the injection is made. For this purpose, I use an instrument known as the varioccluser. This is an oblong metal ring, 3 inches in its long diameter by  $1\frac{1}{2}$  inches in its short. It is provided with a handle by means of which it may be pressed down upon the vein, a segment of which is thus effectually cut off, both proximally and distally. The same result may be obtained by having an assistant use the forefinger

and thumb for compression. For making the injection, I use an ordinary 10 c.c. Luer syringe with a 22 gauge needle; between the syringe and the needle is placed a two-way stop-cock.

The syringe is filled with the solution to be injected, after which the stop-cock is set so that the passage is open from the needle to the exterior, that from the syringe to the needle being closed. With the varioccluser in place, the vein is punctured, and the blood contained in the isolated segment runs out through the stop-cock, allowing the vein to collapse and creating the most favorable condition for the action of the solution on the vein wall. The valve of the stop-cock is then turned so as to open the passage from the needle to the syringe, and the injection is made. Occasionally the pressure in the vein is so low that the blood does not escape; under such circumstances, the valve is turned, a small amount of blood is aspirated into the syringe to be certain that the needle is in the vein, and the injection is then made. No solution should ever be injected until one is absolutely certain that the vein has been entered. Following the injection, the pressure with the varioccluser or with the finger and thumb is maintained for five minutes. A small pad of sterile gauze, held in place by adhesive strips, is placed over the puncture wound, to remain for two or three hours until natural sealing takes place. The patient follows his usual routine thereafter, just as though no treatment had been given.

The amount of solution injected varies, and may be anywhere from 5 to 10, and in some cases, 20 c.c. Enough should be used to fill the isolated segment of vein without causing rupture. In my work, the first injection is usually 5 c.c., regardless of whether the vein is filled or not. I do this in order to test out roughly the susceptibility of the patient's tissues to the solutions used. Following this, if the reaction is more severe than usual, I do not increase the amount of solution at the next injection; otherwise, for the second injection, I employ 10 c.c., and thereafter

as much as needed. For the majority of cases, 10 c.c. is usually sufficient for each succeeding injection.

This, briefly and in general, is the technic which I employ, and by which I have made several hundred injections. It is entirely an office procedure, and causes no disability whatever. Special attention, however, should be called to a few points.

#### DISCUSSION

I make it a rule to administer the treatment in the morning, or if this is not possible, early in the afternoon, I do this in order that several hours may elapse before the patient goes to bed. The recent experiments of McPheeters and Rice<sup>6</sup> have demonstrated conclusively that centripetal current in these dilated veins is extremely sluggish, if not entirely absent, especially in the erect posture. During the interval of time just mentioned, the thrombus has an opportunity to become firmly attached before the horizontal position is assumed. Theoretically, the remote chances of embolism are increased by recumbency shortly after the injection; practically, such an accident probably would not take place, but there is no justification for taking the risk. For this reason, injections in bed-ridden patients are contraindicated.

One must be absolutely certain that the needle is within the lumen of the vein before beginning the injection. As was stated previously, the action of some of the solutions used upon the tissues is disastrous, if any escapes the vessel. Particularly is this true of solutions of sodium chloride and of sodium salicylate. The former gives rise to a peculiar blanching of the tissues, and both quickly cause necrosis and sloughing of large areas. When using either of these, a large syringe full of normal salt solution should be kept at hand: in the event of an injection outside the vein, or of extensive leakage, the tissues should immediately be infiltrated freely and extensively with the physiological saline. While this will not entirely prevent the damage, it causes a marked ameliora-

tion. Sugar solutions do not appear to have this harmful effect upon the tissues; considerable reaction may be produced, but necrosis and sloughing rarely, if ever, occur.

Even though the technic of the injection has been perfect, and it is practically certain that no leakage has occurred, not infrequently certain patients are encountered in whom a decided tissue reaction will take place. This is manifested by a considerable area of redness and induration surrounding the site of the injection, sometimes to a distance of several centimeters. This reddened and indurated area is sore and somewhat painful upon palpation. Such a condition need occasion no alarm. The height of the reaction is usually passed within forty-eight hours, although some induration and increased sensitiveness may remain for several days. Hot fomentations are all the treatment that is necessary, and give prompt relief. In patients presenting this marked reaction, it is my custom to lengthen the interval between the injections, in order that the effects of one may be over before the next is given.

In a few cases, I have noted a localized, transient edema below the site of the injection, apparently in the area drained by the vein which has been occluded. This edema is definitely circumscribed and confined to a small area, it is not painful, gives rise to no inconvenience whatever, and disappears spontaneously within twenty-four hours.

Some writers advise the use of an elastic compression bandage following the injection and during the course of the treatment. I fail to see any necessity for this, and have not used it. In my work, as I have said above, I cover the puncture wound with a small pad of gauze, firmly applied and held in place with adhesive strips. This remains in place for a few hours, until natural sealing takes place, when it is removed by the patient himself.

A few words should be said in regard to pain. With proper technic, the procedure is practically painless. When using solu-

tions of sodium chloride or of sodium salicylate, during or immediately following the injection, painful muscular cramps are sometimes experienced; these also occasionally appear when sugar solutions are used, but much less frequently. Such cramps are evanescent, disappearing shortly after the injection has been completed. The tissue reaction already described and which comes on later, gives rise more to a soreness in the structures affected than to actual pain. Severe pain of any considerable duration, especially if in the area immediately surrounding the point of injection, means that the needle has not entered the vein or that leakage is taking place, and the injection should immediately be discontinued.

In regard to the interval between injections, it is my practice in the average case to inject about twice a week, although the treatment may be given every second or third day. In my opinion, the severity of the reaction should determine the interval, and I prefer to wait until this reaction subsides before again injecting: thus, the length of time intervening may be two days, or it may be a week. It should be emphasized that the treatment must be ambulatory, and there is nothing to be gained by subjecting the patient to unnecessary inconvenience.

Not infrequently patients will be encountered in whom the veins collapse to a marked degree upon the assumption of the reclining position, making the injection very difficult of accomplishment. This may occur even though a tourniquet be previously applied. Under such circumstances, the treatment may be administered with the patient standing, the technic being otherwise the same.

It is my practice to inject the upper part of the dilated veins first; when this is done, it frequently happens that fewer injections lower down are necessary, due to the fact that a main trunk has been occluded, leading to a disappearance of many of the collaterals. In no case, however, should injections be given above the middle third of the thigh. As a rule, I make only

one injection at a sitting, although in the case of a patient with varicose veins in both legs, there is no particular reason why both legs should not be injected at the same time, if desired. However, if the patient should be one of those individuals who react strongly to the injected solution, considerable discomfort would probably result. As already stated, the treatment is, and must be ambulatory; consequently any unnecessary pain and inconvenience is to be avoided. I do not consider two injections into the same leg at one sitting at all advisable; as a matter of fact, the only reason for two injections is to shorten the duration of the treatment, and in the most of these cases, haste is in no wise necessary.

The number of injections necessary varies with each case, and with the number of dilated veins. In a few, one or two will be found to be sufficient; the average, I should say, is from six to eight; and finally, some severe cases will require twelve to fifteen. One must be guided by the conditions present, and inject until all prominent veins are obliterated. It is advisable to keep the patient under occasional observation for six weeks to two months following the completion of the treatment; not infrequently a vein will become apparent which was not to be found earlier, and sometimes complete absorption of the thrombus will be found to have taken place, with consequent non-obliteration of the vein. Such cases require further injections.

#### CONTRAINDICATIONS

Contraindications to the employment of the injection method are extremely few in number. The most important of these is a history of a recent phlebitis. To inject veins which have been the seat of a bacterial inflammation at any time during the preceding year is to my mind a hazardous procedure; preferably the interval should be considerably longer. It is true that some men with extensive experience feel that it is safe to administer treatment after all

pain and evidence of inflammation have completely subsided; for my part, however, I prefer to refuse an occasional case rather than take an unnecessary risk.

And while upon the subject of phlebitis, it must be considered from another important angle. There is no question but that the injected veins may occasionally become the seat of a metastatic infection from some focus elsewhere in the body; such an occurrence is undoubtedly very infrequent, but there is sufficient clinical evidence that it may take place. This being the case, a careful history should be taken of every patient, followed by a thorough general examination; if grossly infected foci are found which are apparently having any decided effect upon the general health of the individual these should be given attention before proceeding with the injections. This has been recently discussed by Kilbourne,<sup>7</sup> and deserves emphasis.

Other conditions which have been advanced as contraindications are old age, nephritis, and extensive edema of the lower extremities indicating deep circulatory disturbances. All of these, in my opinion, are entirely relative. Old age, in itself, provided the patient is otherwise in good general condition, is no reason for withholding injections; if the general health is enfeebled from some cause or other, however, caution should be exercised as it is, well known that such individuals are very liable to thrombophlebitis. Nephritis, unless advanced, I do not consider a contraindication. Edema of the lower extremities must be carefully investigated. The condition very frequently accompanies dilatation and varicosities of the superficial veins, and under such circumstances, a few injections will cause it rapidly to disappear; on the other hand, if it is due to serious disturbances of the circulation in the deeper system of veins, injections will only aggravate it, if indeed, more serious consequences do not follow.

Varicose ulcers are decidedly not a contraindication, but quite the contrary. Treatment by injection constitutes the

most effective and successful means at our disposal today for the rapid and complete cure of these ulcers.

In the employment of this method, untoward results are possible as follows: (1) from toxic action of the injected fluid; (2) from local injury following the injection; (3) from inflammation of the vein following the injection; (4) from gangrene, and (5) from embolism.

The first four of these possibilities may be dismissed with a few words. With the solutions which are generally used today, toxic action is hardly to be thought of, except in the case of an occasional individual who is susceptible to salicylates; under such circumstances, some other preparation should be employed. With proper care in making the injection, there should be no local injury following it. In this connection, it should again be emphasized that extreme care must be exercised in getting into the vein, because these thin-walled, dilated vessels are more difficult to enter than normal ones. Gangrene is to be avoided by first making sure that the deeper system of veins is competent.

#### EMBOLISM

As to embolism, increasingly large numbers of statistics clearly demonstrate that its occurrence following proper injection treatment of varicose veins is much rarer than following operation for the same condition. In these cases, the tendency toward embolism appears primarily to be very slight, and whatever danger exists may be reduced to a minimum and the operation rendered entirely safe by attention to a few principles, as follows:

To begin with, the cases should be properly selected. Patients presenting themselves with veins as large as the thumb or larger are not suitable for this form of treatment, and should be rejected.

The treatment must be ambulatory. This means that the injections must be given eight or ten hours previous to the patient's usual time for retiring; following the injection, he should be instructed to

proceed about his usual daily routine, just as though no treatment had been given.

Injections above the middle third of the thigh are to be avoided.

The first injections should be made as high up as possible in the vein.

Finally, a small amount of fluid should be used for the first injection, in order to ascertain the patient's reaction.

If these principles are observed in all cases treated, no danger of embolism need be feared.

#### SUMMARY

From a considerable study of the literature, and from my own experience, I am convinced that the injection treatment of varicose veins is the best and most successful treatment for this condition which we have at our disposal today. It has the additional advantage of being purely an office procedure and of causing no interruption to the patient's usual routine; consequently it deserves to be widely employed. In this short paper, I have not attempted to be exhaustive; I have merely tried to describe a technic for administering these injections which I have found to be simple and practical, and which, with ordinary care and attention to detail, can be readily utilized by any physician interested in doing this work.

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# INCONTINENCE OF URINE FROM ABERRANT URETER

## REPORT OF A CASE\*

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OF THE many causes of incontinence of urine in the female, one that is quite rare but satisfactory from the standpoint of treatment, is the opening of an aberrant ureter into the vestibule of the vagina. This condition is of course due to a developmental defect and should be borne in mind and sought for in every case of unexplained incontinence, as the cure of the incontinence is dependent on the correct diagnosis and appropriate surgical treatment. Aside from the occurrence of this condition in gross abnormalities, such as absence of the bladder, monstrosities, etc., the first published clinical report that we have been able to find was by Baker in 1878. He recognized the condition and successfully treated it by implantation of the aberrant ureter into the bladder by way of the vagina. Baker thought that he had a unique case but learned from Jackson of a similar case in Boston City Hospital in 1870. He secured the record of this case and included it in his report. Hartman in 1913 reported 21 cases with ureter opening into the vestibule, and Begg in 1927 has reviewed the literature on the subject in an article on "Incontinence of Urine of Renal Origin" in which he reports a case of aberrant ureter opening into the urethra, and has collected all cases reported of ureters opening into the vestibule or urethra. Of those opening into the vestibule, he found 50 cases. I have found 5 additional case reports as follows: Hayward 1, Juvara 1, Winter 1, Kilbane 2. I wish to add to those reported another case of this anomaly.

*Case Report.* (Gynec. No. 1010.) Sr. E. Aged sixteen. St. Francis Hospital, Admitted December 29, 1927. Chief Complaint: Leakage of urine.

*History.* Patient states that as long as she can remember there has been enough leakage of urine to soil her clothing slightly. In the last three years this has been more marked, and patient finds a spot in the bed in the morning. She voids regularly and normally and has no frequency, burning, nor pain on urination.

Menstruation began at fifteen, has been irregular, sometimes flowing twice in one month. Flow lasts five to six days and menstrual cramps are present at times. Last period began on December 27, 1927, and patient is still flowing (two days). No leucorrhea.

She had scarlet fever at nine, but no other serious illness. No operations. There is no history of congenital defects in the family.

*Physical Examination.* Patient is very shy and retiring and it is difficult to get a good history, as she is ashamed of the ailment. She was brought to the hospital by her associates who stated that the urinous odor was very marked. There was nothing of note found in the general physical examination. No tenderness in region of kidneys. The urine was negative for albumin, sugar, blood and pus. Wassermann negative. On vaginal examination, hymen was intact. On rectal examination, the uterus and adnexa felt normal. Bladder was catheterized and clear urine obtained. Five tenths cm. below external urethral orifice and slightly to the right of the midline, drops of clear fluid were seen escaping at intervals from a small orifice which was visible as a small slit, but which gaped when the fluid was escaping. This resembled a ureteral orifice in the periodic escape of a few drops of fluid. There was no steady drip and at times the intervals were quite long between the discharge of the fluid. Attempts were made to collect sufficient fluid for examination but very little could be obtained. It was clear, and on microscopic examination no pus cells were found. Attempts to pass a small probe into the orifice were not successful, but a No. 5 opaque ureteral catheter was finally inserted for a distance of 4 cm. A few drops of clear fluid came through the

\* Presented as a thesis for admission at the Forty-first annual meeting of the American Association of Obstetricians, Gynecologists and Abdominal Surgeons, Toronto, Ont., September 10-12, 1928.

catheter. With the little finger in the vagina, through the unruptured hymen, the catheter could be felt below and to the right of the

catheter placed in the vagina, a photograph was made (Fig. 1).

The x-ray pictures show a very tortuous



FIG. 1. Two No. 7 ureteral catheters in right and left ureters are shown coming out of urethra. Below and to right of external urethral orifice is shown a No. 5 ureteral catheter in anomalous opening, in vestibule, of one component of double right ureter. Other component opens into bladder. Below this is shown a rubber catheter which has been inserted into vagina through unruptured hymen.

urethra. 1 per cent mercurochrome was injected through the ureteral catheter, and the catheterized urine from the bladder, following this procedure, was clear and showed no trace of the dye, from which we assumed that there was no communication with the bladder. No dye escaped from the vagina. Twenty per cent sodium iodide solution was then injected and x-ray plates made. The following day, patient was cystoscoped and bladder mucosa found normal, and right and left orifices found in the normal positions. No. 7 catheters were readily passed into the ureters and No. 5 catheter again inserted into the anomalous opening, and kidney function test with intramuscular injection of 1 c.c. of phenylsulphonaphthalein was done. The dye appeared on the right side in fourteen and one-half minutes and on left side in fifteen minutes. There was no flow from the catheter in the anomalous opening, so that the appearance time of dye could not be determined. Five cubic centimeters of sodium iodide solution was then injected into each catheter and allowed to remain until x-ray plates were made. With ureteral catheters in place and a soft rubber



FIG. 2. Shows opaque ureteral catheter in tortuous passage where obstruction was encountered 4 cm. from orifice. Branching off from this is ureter which seems to end in an ovoid dilatation. Ureter is actually dilated all way to kidney but is filled with urine and opaque fluid reaches only lower part of dilated portion.

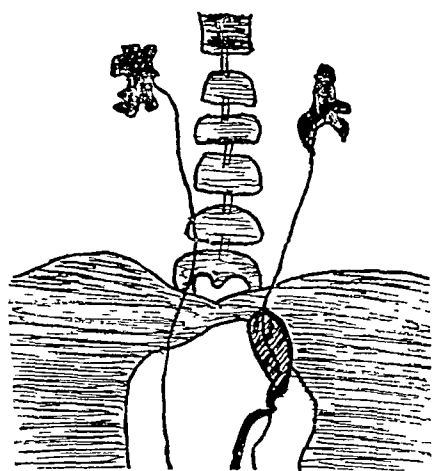
passage containing the No. 5 opaque ureteral catheter which seems to end in a blind passage (Fig. 2). Near the upper end of this passage and branching from it is a normal looking ureterogram extending up the right side of the region of the brim of the pelvis where it ends in an ovoid dilatation. Figure 3 shows this to be distinct from normal right ureter. The ovoid dilatation in the region of the brim of the pelvis gave the impression that this was a case of normal bilateral kidneys and ureters and a third ectopic kidney in the pelvis with a ureter that opened into the vestibule. As only a small portion of the urinary output escaped through this orifice, it was felt that it was an unnecessary nuisance and operation advised for removal of the pelvic kidney.

**Operation.** January 7, 1928. Before operation a No. 7 catheter was placed in the right ureter as a guide. Under spinal anesthesia, abdomen was opened through low midline incision, the intestines were lifted and gauze pad placed so as to hold them out of the pelvis. It was noted that the cornua of the uterus were

prominent, with a tendency to bicornuate uterus. Tubes and ovaries were negative. Beginning about 1 inch above the base of the



FIG. 3. Pyelograms and anomalous ureter. Photograph fails to show what can be seen on x-ray plate that two ureters on right side are distinctly separated as is indicated in accompanying sketch (Fig. 3a).



F.G. 3a

right broad ligament and coursing upward over the brim of the pelvis was a bluish colored, retroperitoneal, elongated sac about 2 cm. in diameter. It was somewhat tense and was

recognized as a dilated ureter. It lay directly over the right ureter in which could readily be felt the ureteral catheter. The peritoneum was incised over the dilated ureter and reflected back. A plexus of veins surrounded the dilated ureter. The ureter narrowed from above downward in a spindlelike manner to about 1 inch above the base of the broad ligament where it was found to be normal in size. The ureter was not opened to determine if there was a stricture here. The dilated portion could be traced upward to the level of the kidney. The lower half of the kidney was slightly larger than normal and felt normal in every way. The upper one-half of the kidney was smaller and more firm and irregular as though cirrhotic. A diagnosis was made of double kidney and ureter, the ureter from lower pelvis opening into the bladder and the ureter from the upper pelvis opening into vestibule of the vagina. As the urine was clear and showed no evidence of infection, excision of the dilated portion of the ureter and upper one-half of the kidney was not thought to be necessary, so the ureter was ligated and divided, below the dilated portion, near the base of the broad ligament where the ureter was normal in size. Through a small muscle splitting incision, a rubber-tissue-drain was carried extra-peritoneally to stump of ureter (probably an unnecessary precaution). The incised peritoneum over the dilated ureter was sutured. The appendix containing a large fecolith causing a fusiform swelling at the tip, so the appendix was removed and midline incision closed without drainage. The rubber-tissue-drain was partly removed in three days; and entirely removed on the fourth day, and patient made an uneventful recovery. There was no incontinence of urine after operation and no pain in region of right kidney.

#### COMMENT

The interesting features of this case are:

1. The relatively small amount of total urinary output that escaped by way of the aberrant ureter, sufficient only to soil clothing in the day and leave a small spot in the bed at night.

2. The upper dilated portion of the ureter, filled with urine, could not be reached and emptied with the ureteral catheter, so that the injected sodium iodide solution produced a sense of fulness

in region of kidney as though the kidney pelvis were filled, but actually reached only the first portion of the dilated ureter. The ovoid shadow produced here simulated a dilated pelvis of a pelvic kidney.

3. The absence of infection permitted ligation of the ureter as the only operative procedure necessary for the relief of the incontinence. The dilatation of the ureter in this case began higher than is usual in the cases reported. Whether it was a congenital dilatation of the ureter or a stricture of the ureter with dilatation above it, or a valve such as was found by Hunner was not determined, as the ureter was not opened nor excised.

#### ETIOLOGY

In incontinence due to the ureter opening into the vestibule, there may be a single kidney and ureter on the side involved, but more commonly (in 91 per cent of cases reported) there is a double ureter, the one opening into the bladder and the other into the vestibule. Usually the kidney and ureter of the other side are normal, but in some cases there is double ureter on both sides.

Double ureter is not uncommon but, as a rule, both openings are in the bladder and give rise to no clinical symptoms. Occasionally, however, one component is extravascular and is the cause of the incontinence here considered associated with normal micturition. This anomaly may occur in both sexes. The most satisfactory explanation for this condition was found in Begg's article and illustrated by Figure 4. According to Felix the upper part of the bladder is formed normally from the ventral cloaca, while the trigone is formed from the expanded lower portions of the Wolffian ducts, from the dorsal surfaces of which the original renal buds or future ureters develop. As the Wolffian duct lengthens, after the formation of the trigone, the loop of it passes down internal to the ureter, expanding as it goes, and part of its walls form the urethra and

vestibule. When development is complete, it remains in position as Gärtner's duct. If the renal bud is placed high, the trigone

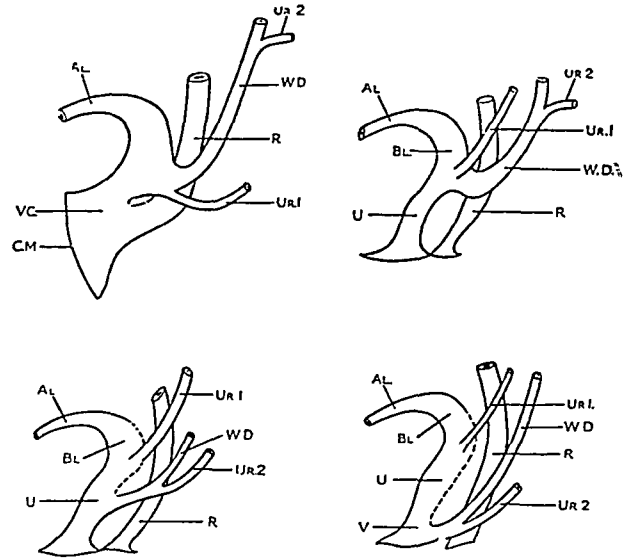


FIG. 4. Diagrams illustrating how lower ureter may open into bladder, and upper ureter into urethra or vestibule. Portions of wall of expanding Wolffian duct form trigone, urethra and vestibule as indicated by dotted line in lower diagrams:

A.L., Allantois; R., rectum; UR. 2, upper ureter; V.C., ventral cloaca; W.D. Wolffian duct; C.M., cloacal membrane; UR. 1, lower ureter; U and V., represent the portions that will form urethra and vestibule.

may be formed from the expanded lower end of the Wolffian duct before the portion from which the ureter springs has descended and the ureter may then finally open into the urethra or vestibule, depending on which of these structures are formed from the portion to which the ureter is attached. If it is placed so high that descent of the Wolffian duct has ceased before the part to which the ureter is attached is used in the formation of the vestibule and urethra, it then opens into Gärtner's duct and the flow of urine may keep Gärtner's duct patent. This may be the true condition in many cases of aberrant ureters discharging their contents into the vestibule. In the case reported here the marked tortuosity of the canal for  $1\frac{1}{2}$  inch within the orifice as shown in Figure 2, the course of the opaque catheter the tip of which seems to end blindly, while the ureter seems to branch off from the side of the canal, is

evidence in favor of the theory that the distal portion of the canal is Gärtner's duct and not the true ureter in this case.

In double ureter two renal buds arise from the same Wolffian duct. Usually, they lie close together and open close together in the bladder. If one arises much higher than the other, the lower one may open into the bladder at approximately the normal position, while the upper one later descends to open into urethra or vestibule. This explains why the ureter with extravesical opening always comes from the upper pelvis of the double kidney.

#### PATHOLOGY

Of the 56 cases reported, including the one reported in this paper, with termination of ureter in vestibule, 5 were single ureters, and 51 were components of double ureters. The right side is more commonly involved than the left, and the opening is usually to one side of the midline, thus indicating from which kidney the ureter comes. The opening usually lies at the edge of the external urethral orifice or a short distance from it as in my case. (Fig. 1.) It is round or slitlike and usually quite small so that it is difficult to pass a probe or a small catheter. On passing a catheter, obstruction is often encountered from 1 to 2 inches from the orifice. This has been attributed to stricture, or angulation of the ureter due to fixation near the normal site or entry of the ureter into the bladder, or possibly to the ureter entering a patent Gärtner's duct, which was strongly indicated in my case. The ureter is usually dilated due to stricture at the orifice, or strictures higher in its course. Through the vagina it is possible to palpate the dilated ureter as a cystic swelling, in many instances. As this anomaly usually occurs with double kidney and ureter, it is the rule, as one would expect from the embryology, that the ureter with extravesical opening arises from the upper kidney pelvis. The urine is usually infected and this is important in regard to treatment. Function

is decreased in the portion of the kidney involved, as a rule.

#### SYMPTOMS

The characteristic symptom is incontinence, day and night, along with normal micturition. As the kidney function is usually below normal and as the ureter is usually dilated and acts as a reservoir, the amount of urine escaping is often small in amount and quite variable as to time and quantity. It may be influenced by posture, exercise, etc. There may be pain in the region of the kidney due to back-pressure or infection. Urinous odor and irritation of mucous membrane and skin of vulva and thighs is common. This type of incontinence in the female may be due also to an aberrant ureter opening into the urethra, but is more common in the vestibule ( $3\frac{1}{2}$  to 1). In the male, the aberrant ureter opens into the prostatic urethra, seminal vesicle, or vas deferens. As these openings are behind the external sphincter, there is frequency of urination, but not incontinence as in the female.

#### DIAGNOSIS

Many of these cases are undoubtedly missed because the condition is not borne in mind as a cause of incontinence. The characteristic type of incontinence should call attention to the possibility of this condition and a search made for the extravesical orifice. Preceding the examination the patient should be given large quantities of water in order to increase the flow of urine, and then a careful inspection of the vestibule should be made for the escape of urine. Since the intervals between the discharge of urine were quite long in the above case, several examinations may be necessary where the condition is suspected. As the incontinence may be due to the ureter opening into the urethra. Furniss has recommended the insertion of wet cotton pledgets into the urethra, the vagina, and the vestibule following the injection of indigo-carmin, to determine from which of these three sites the colored

urine escapes. After locating the orifice it will be noticed that urine escapes intermittently as from the ureteral orifice in the bladder, but often with less regularity. On vaginal examination it may be possible to palpate the cystic dilatation of the ureter above the external orifice. If the orifice lies to the side of the midline it indicates that the ureter comes from the side in which the orifice is located. It may be necessary to dilate the small orifice in order to introduce a small ureteral catheter. Injection of sodium iodide followed by x-ray examination is a valuable aid in determining the side involved, the course and degree of dilatation of the ureter, and the form of the kidney pelvis. It must be remembered, however, that if it is not possible to pass a catheter far enough to empty the dilated portion of the ureter, the x-ray examination may be confusing. This was true in my case where it was not possible to pass the catheter more than  $1\frac{1}{2}$  inches. The ureter was dilated and tense with retained urine above this portion, so that it was not possible to inject the sodium iodide solution to the kidney, and the x-ray pictures gave the impression of a third kidney at the brim of the pelvis (Fig. 3). Similar apparent sacculations were found by Kilbane and also by Low and Epler, due to stricture above. This should be borne in mind before assuming that there is a third kidney present. Except for the difference in location, Herbst's skiagram of a rudimentary upper pelvis is very similar to the skiagram of dilatation of the ureter shown in Figure 2.

On cystoscopic examination, the presence or absence of a ureteral orifice on the corresponding side of the trigone determines whether the aberrant ureter is single or a component of a double ureter. If the latter, the function and the presence or absence of infection in this portion of the kidney emptying into the bladder can be determined. Simultaneous ureterograms of each component will determine the relation of the aberrant to the normally placed ureter. The urine from the aberrant

ureter should be examined for pus and microorganisms.

#### TREATMENT

Various procedures have been used to cure the annoying incontinence and at the same time preserve the kidney or portion of kidney involved. In case of single ureter with good function of the kidney involved, implantation of the ureter in the bladder is indicated. Implantation by way of the vagina has not proved very satisfactory and has frequently resulted in vesicovaginal fistula, requiring multiple operations. Judd advocates abdominal extraperitoneal implantation as more satisfactory. He performed this operation in the presence of infected urine, and with careful after-treatment and lavage of kidney pelvis obtained a fairly satisfactory result.

In the absence of infection in a case of double ureter, ligation of the aberrant ureter is sufficient for cure. In the case here reported this was done through the abdomen. A catheter in the normally placed component of the double ureter was a valuable aid in differentiating it from the aberrant component. It is much simpler to ligate from below by dissecting out and resecting the lower end of the ureter by way of the vagina. Kilbane and Furniss both doubt the advisability of ligating the ureter in any instance. In the case above reported where the function of both kidneys emptying into the bladder was good while that of the portion of the kidney secreting through the aberrant ureter was much below normal, the ureter was dilated high up, possibly due to stricture, and the urine was not infected, ligation was simpler and surer than implantation into the bladder, and less formidable than resection of the kidney. To satisfactorily implant the ureter into the bladder in this case, it would have been necessary to open the ureter in the dilated portion and dilate the ureter below this level to overcome stricture before implantation into the bladder. It is also true that

implantation has not been altogether satisfactory. Some of the cases could not be catheterized after a few months and function ceased, due to contracture of the orifice, so that in the end the result was practically a ligation.

Unfortunately, most of the cases are not so favorable for ligation as the one here reported. The usual case is one in which the ureter is dilated, the kidney function impaired and infection present, and with a normal kidney on the other side nephrectomy is usually done, either removal of the entire kidney or resection of the upper portion with its pelvis and dilated ureter. The latter procedure is probably the one of choice in most cases. A sulcus usually marks the limitation of the upper pole, and by a wedge-shaped incision at this level, the upper pole may be excised. Care must be taken to preserve the blood supply of the remaining portion of the kidney and this operation is best performed when each portion of the kidney has an independent blood supply.

#### SUMMARY

1. There is a type of incontinence of urine in the female, associated with normal micturition, which is due to the opening

of an aberrant ureter into the vestibule or urethra.

2. The aberrant ureter may be single, but there is usually a double ureter, one part opening into the bladder and the other outside of the bladder.

3. The aberrant ureter is usually stricture, dilated, infected and associated with the upper half of the kidney with impaired function.

4. The diagnosis is made by the character of the incontinence, the finding of the external orifice, and cystoscopic and x-ray examinations.

5. The treatment is implantation of the ureter into the bladder, ligation of the ureter in clean cases, or in the majority of cases resection of the infected kidney or portion of kidney.

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# OSTEOMYELITIS\*

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**O**STEOMYELITIS is an inflammation of the marrow of the bone, and may be acute or chronic. Its point of origin depends on whether the bone infection is primary or secondary. When bone suppuration results from compound fractures or punctured wounds, it begins at the point of inoculation, but when it is caused by bacteria, usually *Staphylococcus aureus*, conveyed from some focus of infection to the bone through the blood or lymph vessels, it ordinarily begins in the juxta-epiphyseal region. The rapidity with which the invading bacteria destroys the surrounding bone, depends largely on their virulency, the resistance of the surrounding tissue, and the ability of the pus to escape from its point of origin.

In the primary cases the portal of entry frequently remains open, providing a most favorable type of drainage with repair proportional to the amount of mechanical, but non-destructive cleansing of the minute areas of the infected bone. However, in the secondary there is a very different situation with the acute cases. The blood current in the sinus-like vessels is slowed at the seat of election for this disease. Then some slight injury is sufficient to produce in the delicate epiphyseal tissue a bruising of the vessels and an effusion of blood which temporarily interferes with the nutrition of the part. Minute fractures of the bony trabeculae are frequently found after such injuries. At these points the bacteria which may be circulating in the blood move in a comparatively confined vascular area, and readily find lodgment in the bruised tissues or the blood clots.

Where the pathological process originates, the tissues are very unyielding and this greatly favors a rapid spread of the inflammation through the Haversian canals, through which the blood vessels

pass. Swelling, which is the saving and essential characteristic of inflammation, cannot take place in the bone in osteomyelitis. As soon as the limit of expansion in the marrow is reached, the products of inflammation next exert themselves on the internal blood supply of the bone. The blood vessels are quickly occluded, the nourishment of the bone lying within the periosteum is cut off, the circulation being supplanted by stasis and coagulation. This dead structure is rapidly infected, resulting in necrosis and abscess. Pus under pressure is the most dangerous thing in the animal organism, and this exists in acute osteomyelitis as in no other disease. It is one of the most serious of diseases. Loss of life is common, permanent disability may be expected in a large percentage of cases, and bone destruction in every case.

The clinical picture is that of a severe illness, often beginning with delirium and prostration before evidence of affection of any bone. There may be rigor, general illness, severe headache, vomiting, rapid pulse, pain in the limbs, and sometimes convulsions. The temperature is septic, often going to 104°F. There is a marked leucocytosis. Pain is intense in one or more of the bones. Any movement of the neighboring joint or jarring of the limb causes agony. Intense tenderness can be produced by the most gentle pressure. A tap on the bone some distance from the maximum point of tenderness will cause severe pain at that point, but no discomfort where the tap was made. Swelling is not an early sign, and that with redness appear only after the moment for advantageous treatment is long passed. In the early diagnosis of the disease the roentgen ray is of no value.

The differential diagnosis is of upmost importance. In acute rheumatism the pain

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shifts from place to place, rigors are absent, the lesion is in the joints and is multiple, heart affections are early and the lesion never leads to suppuration. In acute osteomyelitis, on the other hand, the pain is constant in one spot, rigors are present, the lesion is in the bone and is usually single, heart affections are late, and the lesion leads rapidly to suppuration. In cellulitis the bone itself is not tender and the movements of the extremity, though painful, are free. With erythema nodosum over the tibia the patient has good health, free movement of the part, and there is a peculiar purplish appearance to the part. It is more difficult to differentiate from scurvy, rickets and acute periostitis which have a whitish, somewhat edematous appearance of the skin and superficial tissues. Also movements are painful and bones are tender on pressure and frequently limited to one bone at first. Fever is absent and other signs of rickets are present. Erysipelas over the tibia gives signs closely resembling acute osteomyelitis.

The prognosis should always be guarded. By early recognition and thorough treatment much illness is prevented, necrosis limited, formation of persistent sinuses often prevented, and the patient is comparatively soon out of danger.

There is only one treatment and that is operative. At the point of maximum tenderness expose the bone and evacuate the pus either by the removal of a generous piece of bone or by drilling several holes. Many methods may now be employed for drainage and to aid bone and tissue regeneration. The one which gives the greatest mechanical cleansing, with a non-irritating solution, or pack, generally gives the more rapid, and more often permanent healing. Those most widely used now are the Carrel-Dakin and the Orr vaseline packs with immobilization of the part. Since 1919 I have used the Taylor<sup>1</sup> liquid-tight appliance with most excellent results.

<sup>1</sup>I have followed closely the teachings of Drs. W. H. and N. B. Taylor of Toronto, Canada, in the use of their liquid tight appliance, and I make no claim of original work while using it.

After evacuation of the pus destruction ceases. Such portions of the periosteum and medulla as have retained their vitality resume their bone-forming functions. A covering of new bone is now being formed around the area of necrosis and is called the involucrum. This is perforated by apertures called cloacae, through which pus flows profusely. The dead bone which lies adjoining, or within, the involucrum is a marked stimulant to the surrounding tissues. When it is finally completely separated from the living bone, largely through the activity of the osteoclasts, it is called a sequestrum. This may be a part of the outer covering of the diseased bone, and, if left alone, may be expelled through the fistulous opening in the integument. Not infrequently large fragments of bone may be extruded in this way. If the sequestrum has become imprisoned within the wall of new bone, it will be necessary to remove a piece from the wall large enough for the removal of the dead bone.

We have now come to one of the most difficult problems in surgery, that of chronic osteomyelitis. The type which has just been described follows the acute or subacute and is caused by the pyogenic organisms. Another type is Brodie's abscess. It is a small, circumscribed, cold abscess in the shaft of long bones and its etiology is not definitely known. Still another type is chronic (non-suppurative) hemorrhagic osteomyelitis. It begins in the same areas of bone structure as the acute form. The process of bone disintegration is very slow. It follows injuries of moderate or even slight severity.

The lesions of tuberculosis of the bones with their accompanying abscesses are very familiar to every practitioner. However, we must differentiate that lesion from those closely resembling it, so that we will make the mistake of tagging every chronic abscess of a bone with the diagnosis of tuberculosis.

Congenital syphilis causes bone lesions which are constantly being treated for

tuberculosis and with disastrous results. A negative Wassermann reaction should not rule out congenital syphilis.

Bone cysts and tumors frequently resemble chronic osteomyelitis.

The discussion of treatment will be confined to that of chronic osteomyelitis caused by the pyogenic organisms.

Many different treatments were used for a few months or years, and given up because of their failure to accomplish what its originator claimed for it. Many cases did not heal. Of these which did heal many broke down afterwards, leaving sinuses communicating with cavities in the interior of the bone. Attempts were made to completely sterilize the abscess cavities with some strong antiseptic, as pure carbolic acid, followed by alcohol, after using the chisel or curette. Frequently this caused a superficial necrosis, resulting in the formation of another sequestrum. Many investigators are hoping to find an antiseptic that will sterilize the abscess cavity and not damage the tissues. For some time it was thought that Dakin's solution with Carrel's technic had solved the problem. I have given the method a fair trial and I do not believe there is any particular advantage in it, or that it is the use of the antiseptic that materially influences the course of the disease.

Still believing that if the cavity could be thoroughly cleansed and filled with a foreign body which would prevent further necrosis and stimulate osteogenesis, the following methods were tried. Most of them have been discarded because they met with too high a percentage of failures.

Following the experiments of Lister, that sterile blood clot rapidly undergoes organization, being converted into new bone in two or three months, several investigators sterilized the cavity with a strong antiseptic and immediately sutured the periosteum, muscles and skin. The results were varied.

The bismuth-iodoform paste of Morison was lightly packed in the cavity and a rubber drain used for forty-eight hours.

Beck's bismuth and vaseline paste has met with a varying degree of success, and is still quite extensively used. Cavities have been filled with bone dust, bone fragments, or the decalcified bone chips of Senn, but met with a high percentage of failures because of the presence of sepsis in the cavity.

After an attempt at sterilization, Hamilton, filled the septic cavities with pieces of sponge, but with poor results. Iodoform gauze, antiseptic cotton, catgut, and other organic substances have been used to obliterate the cavity after an attempt at sterilization, all meeting with frequent failure.

Many successful cases have been reported from the use of the pedunculated flaps of fascia or muscle which have been allowed to fall into and practically fill the cavity. Here the living flap rapidly adheres and supplies the much-needed nourishment, not only for osteogenesis, but for combating the remaining infection. The vitality of these flaps is not interfered with by the presence of mild infection.

The older methods of simple or multiple incisions with rubber tubing or gauze drains and moist dressings, the continuous bath kept at about 102°F. or the wide open wound packed lightly with moist dressings, are still in use and meeting with an encouraging percentage of success.

There have been many failures and a few brilliant results following extensive subperiosteal resection. The operation, both immediate and delayed, should be strongly condemned. However, when a long bone has been destroyed, or the shaft of the tibia removed for necrosis, a fibula has been successfully used to fill the gap.

As the Carrel-Dakin method completely neglects the numerous small pockets of pus leading off from the main cavity, the infection frequently spreads, necessitating an early re-opening of the abscess cavity.

It is not the value of any antiseptic solution, but the thorough mechanical cleansing and greatest possible dilution of the septic agent, that allows an abscess

cavity to completely heal. That is why I gave up the Carrel-Dakin method nine years ago, and have used the Taylor liquid-tight method since then. By means of a liquid-tight appliance, a wound may easily be inundated to its remote parts. Although any solution may be used, a 5 per cent salt solution gives most excellent results. Because of its osmotic character it opens the way to the hidden pockets causing cleansing and healing the same as in the main cavity. Usually after thirty-six hours the suppurative processes have been brought to a standstill by carrying the pus away as soon as it is formed, and rendering the bacteria inert through dilution.

When the level of the fluid in the supplying reservoir is 18 in. above the surface of the wound, the fluid will continue to flow until the wound and all its offshoots are inundated. Then the flow will cease and the pressure becomes equalized throughout all parts of the system. There is nothing violent about this fluid pressure. It is a gentle but very insistent seepage which occurs, probably taking several hours for the fluid to permeate all depths of a wound. The pus mixes freely with the irrigating fluid, and after the seventh cycle there will be a dilution of one in several millions, which is one of the most valuable aids in removing infection and allowing healthy granulations to form. A cycle is usually the inflow (positive pressure) for one hour and the outflow (negative pressure) for fifteen minutes.

The negative pressure established hyperemia and lymphorrhea, which are of greater importance than the thorough cleansing of the cavity.

Heat, which is often necessary to promote an adequate reaction in a wound, can be used to any temperature which the surgeon feels is to the best advantage for healing. The temperature of the fluid may be raised each time a fresh supply is run in from the reservoir.

The salt solution does not water-log the tissues. On the other hand, it has strong

osmotic properties, rapidly reducing swelling and drawing bacteria from remote pockets, where other solutions could not reach them. In long-standing cases the bacterial count usually increases markedly during the early stages of the treatment. It then drops rapidly to its previous level, then to a very few or none, in several fields. Swelling and tenderness disappear very rapidly. The thick exudate of pus changes to clear serum in from three to seven days. The appliance is then discontinued. A closed sterile safety-pin for drainage, and dry sterile dressings changed daily, is all that will be necessary.

If the exudate changes to pus before healing takes place, repeat the irrigations for two or three days. It has been a dictum for ages, "where there is pus let it out." Dr. Taylor says, "ebb and flow irrigation goes a step further and insists: where there is pus wash it out and keep it washed out."

In Dr. Orr's own words:

The proposition upon which the treatment of wounds by drainage and rest was worked out as follows:

1. Primary asepsis or antisepsis to reduce the focal infection. It is not attempted to remove all infection or all diseased tissue. The patient is relied upon to take care of a part of his infection if he is properly assisted and protected.

2. Adequate drainage.

3. A postoperative dressing or method that will protect the wound and the injured or diseased part so that the wound and the part are at rest and there is no opportunity for re-infection.

4. Immobilize so that movement, pain, and muscle spasm are entirely relieved.

The exact technic is as follows:

1. Make a fairly large incision over the infected bone area. Spread apart the skin, muscles, fasciae, and periosteum just far enough to afford access to the diseased area and no farther.

2. Chisel a window into the affected bone area large enough so that all diseased bone may be removed and so that there are no overhanging edges of bone over the diseased area. (Less extensive in acute cases.)

3. Clean out the diseased area gently with a curette or gouge, being careful to refrain from unnecessarily damaging the tissues undergoing repair.

4. Dry the wound and wipe out with 10 per cent iodine followed by 95 per cent alcohol.

5. Pack the entire wound wide open but not tightly with a sterile petrolatum gauze pack. Cover this with a dry sterile pad and bandage on.

6. Apply a plaster cast.

7. Finally, the cast is not to be split nor are windows to be cut in the cast until the wound dressing becomes necessary, which may not be required for several weeks. Complete healing may be obtained with a few dressings at intervals of from ten days to four weeks.

As all the orthopedic services at the Los Angeles General Hospital have been using the Orr treatment during the past two years, I shall give a brief summary of the results. There have been about 50 cases during that time. Five chronic cases were healed in from three to five months. The last one left the hospital about six months ago and so far there has been no recurrence. They were packed on an average of from two to four weeks. If they were not draining very much then only once in two months. The longest chronic case is of

nineteen months' duration, is still in the hospital, not healed but greatly improved.

The acute cases, including an acute recurrence of an old osteomyelitis, healed in from four to seven months with a few recurrences. One acute case which was in the hospital fifteen months left two weeks ago, apparently completely healed.

The conservative management of chronic osteomyelitis will prevent, far more frequently than radical procedures, the miserable train which follows prolonged infection, that of ankylosis or restricted movement of joints, destruction and sclerosis of muscle, necrosis and non-union of bone, to say nothing of lowered morale.

I heartily agree with Brickner when he says:

I quite appreciate, and I too have often yielded to, the temptation to perform an extensive osteotomy in these cases of chronic osteomyelitis with sinuses, suppuration and one or more sequestrums. One hopes by chiseling and scraping away to a solid column of so-called healthy bone to eradicate the disease process at once, and to effect a prompt and permanent wound closure. How often such hopes are disappointed! Every chisel stroke, every scrape of the curet is an invitation to fresh sequestrum formation; and the extensive osteotomy often serves to delay rather than to hasten the cure.



# MILK INJECTION IN PELVIC INFECTION\*

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IT IS generally accepted that the use of foreign protein therapy is sound and productive of good results in a great many cases. It is also safe to state that the great majority of workers have adopted sterile cow's milk as the agent of choice. Robert Schmidt of Prague,<sup>1</sup> who introduced the procedure, "selected milk because it was always available even in the remotest village and because its source, the organism of the cow, seemed to him as reliable as any laboratory."

It is our practice on the Second Gynecological Division, Harlem Hospital, Service of Dr. H. C. Falk, to use plain cow's milk from which the top cream has been removed, boiled in a water bath for ten minutes in a sterile test tube. Ordinary ice box milk is used simply because of the item of expense; while satisfactory, it is recognized that the wide possible bacterial variation in certified milk and milk that has been opened and exposed constitutes a real barrier to accurate scientific observation.

The effect on the organism of the injection of sterile milk, as stated by Gellhorn,<sup>2</sup> Petersen<sup>3</sup> and others, may be summed up as "due to plasma activation. All the cells of the organism are stimulated to greater activity none more so than those cells which have been weakened or paralyzed by infection." Leucocytes are increased in number and are more active; there is consequent increased production of antibodies and enzymes. There is also increased tolerance to intoxication and increase in permeability of the capillaries, promoting increased lymph flow and freer exchange between blood plasma and cell content. Clinically, there is usually increased activation in the lesion, evidenced by swelling, some febrile reaction and

increase in tenderness, which soon subsides with prompt improvement of subjective and objective symptoms.

## CONTRAINDICATIONS

Pulmonary tuberculosis, alcoholism, various cardiac lesions and diabetes are recognized contraindications. Pregnancy is also listed as a contraindication. We have not used milk injections in any case of pregnancy; therefore, we are unable to record any experience. Petersen<sup>3</sup> warns against its use if there is a history of hypersensitiveness, asthma, urticaria, angioneurotic edema. Recognizing this possibility, although Gellhorn<sup>2</sup> states, "anaphylactic shock need not be feared; only three cases of this kind have been reported in the literature of the world," we have not as yet felt it necessary to inject intradermally a small amount of milk to determine sensitivity.

Reactions varying from slight local tenderness to severe constitutional effects, such as chills, fever and vomiting, are described. In the great majority of cases reactions do not constitute an objection to this method of treatment.

We have observed no cases of abscess formation and no induration or local irritation other than transient in our cases. We should hesitate, however, to use non-sterilized milk, although Duke<sup>4</sup> "uses pasteurized hospital milk kept in ice-box at temperature of 50°F. This milk is not sterilized but is centrifuged and the milk drawn up into the syringe with the needle well below the cream line." He also states, "in a short series there was no abscess formation and patients experienced only a temporary discomfort or soreness."

In our 22 cases, 14 had no reactions. Three cases were recorded as having

\* Read before the Clinical Society of Harlem Hospital, October 31, 1929.

reactions. In one case there was a slight chill after the first injection (this patient had five injections). In 2 cases there was a moderately severe reaction with leg and general body pains after the first injection. In one case the reaction was so severe, with headache, vomiting, joint pains, and malaise coming on about two hours after injections, the milk was discontinued after the third injection. This patient, while she had an increase in temperature and a marked increase in leucocytes, felt distinctly worse. Most observers agree that the mild reactions might possibly be due to the accidental injection of a small amount of milk into a vein. It is also agreed that it is good practice to make sure a vein has not been punctured by withdrawing the piston a trifle before injecting. Surface anesthesia by ethyl chloride spray allays nervous apprehension and is distinctly worthwhile.

Averett<sup>5</sup> reports "in first six cases violent reactions, severe chills, fever and refusal of patient to continue." Since the general use of fat free milk as suggested by Graves<sup>6</sup> it is uncommon to find reports of consecutive violent reactions.

#### EFFECT ON TEMPERATURE

The temperature was recorded before and six hours after injection. As a rule, the temperature showed a rise of from 2° to 3°F., the average being 1.5°. The next day there was a reduction in temperature from 1° to 3°F., showing a net reduction of about 1°. The temperature was normal after two injections in 3 cases; after three injections in 3 cases; after three injections in 4 cases. The average number of injections given was 4.8. In one case the milk was discontinued after five injections, the temperature becoming normal three days after the last injection.

#### EFFECT ON LEUCOCYTE COUNT

Averett<sup>5</sup> states: "I have found a leucopenia with a decrease in polynuclear but increase in lymphocytes chiefly the small lymphocytes."

The leucocyte count total and differential was taken immediately before and six hours after injection. There was an increase in the total count of from 2000 to 8000, the average increase being 3000 to 4000. For some reason, in a small percentage of cases there was a decrease in the polymorphonuclear count, amounting to from 4 to 10 per cent. Our experience thus differs from that Averett and conforms to the experience of the majority of workers.

#### EFFECT ON CLINICAL COURSE

Twelve patients were promptly and distinctly improved. One patient was not benefited; 2 patients did not feel distinct improvement until three days after the injections were discontinued. In the majority of cases clinical improvement was marked after the second and third injections.

No patient was given milk injection until five to seven days of conservative treatment had failed to reduce temperature and afford subjective relief. Upon admission each case of pelvic inflammation is immediately put on conservative treatment: absolute rest in bed, elevation of head of bed, ice bag to abdomen, low simple enema daily or every other day, hot alkaline douches morning and night. This routine is usually sufficient to effect reduction of temperature and marked clinical improvement in five to seven days. The cases in this report failed to respond to this routine; their improvement, in our opinion, was unquestionably due solely to foreign protein therapy. Included in this report are:

	Cases
Pelvic cellulitis	3
Pyosalpinx	9
Postabortal sepsis	4
Sepsis with parametritis	4
Gonorrheal arthritis.	1
Pelvic peritonitis	1

It seems reasonable, therefore, to conclude:

1. Milk injection is a valuable adjunct

in the conservative treatment of pelvic infection.

2. It is without uncomfortable local or systemic reaction except in a very small percentage of cases.

3. Marked increase in the total leucocyte count and a corresponding increase in the polymorphonuclear is the rule; in 75 per cent of cases the temperature promptly returned to normal after milk injections.

4. Definite clinical improvement was noted in 60 per cent of cases.

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## SPINAL ANESTHESIA AND SHOCK STRETCHER\*

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THE stretcher illustrated was suggested by the ill effects caused by the transportation of spinal anesthesia

slots on one of the transverse bars of the stretcher. These slots are so placed that they are adjustable to three widths. The

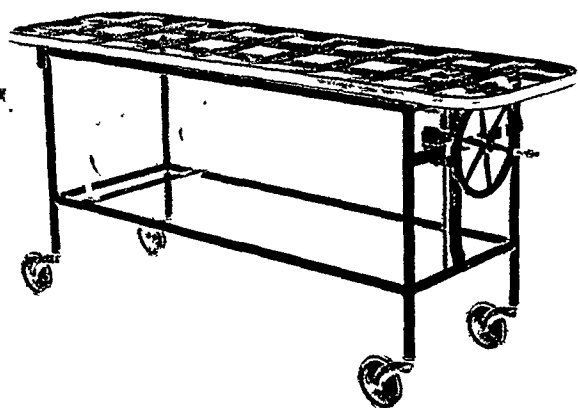


FIG. 1.

patients from the operating table to their beds on the ordinary stretcher, on which it was impossible to maintain a head low position, so vital in these cases.

The new stretcher provides for this position by being hinged at the head end, and the desired foot elevation obtained by operating a worm gear by means of a handle at the foot end of the stretcher.

Shoulder braces, which prevent the patient from sliding, are slipped into

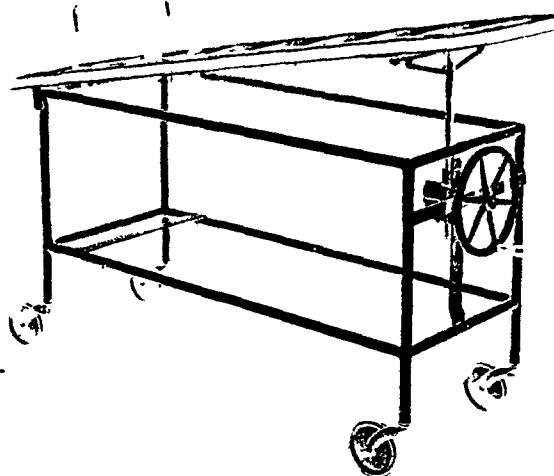


FIG. 2

lower framework of the stretcher is fitted to hold the braces when not in use.

This stretcher has also been used to great advantage in tonsil and adenoid cases and in cases of shock. For pelvic drainage cases it can be used in the reverse position, and in any case as the ordinary stretcher.

\* Submitted for publication November 9, 1929.





those bones. The acetabulum is fractured only when sufficient force is applied to the shaft of the femur just below the

Boorstein<sup>1</sup> reports 6 cases of separation of the symphysis pubis in pregnant women due to difficult labor, the injudicious use



FIG. 1. Roentgenogram of Case xxx, showing four fractures of pubis.

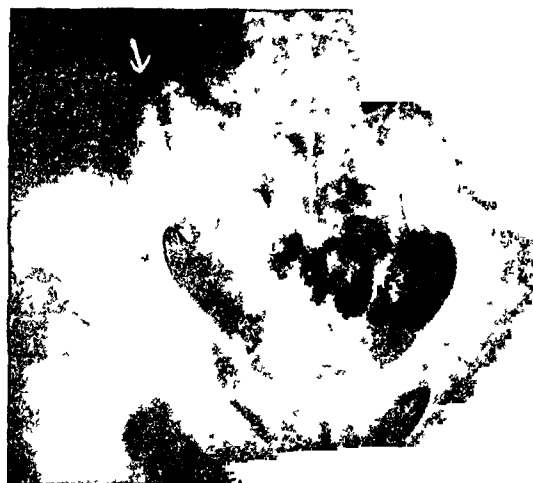


FIG. 2. Roentgenogram of Case iv. Double vertical fracture of Malgaigne.

greater trochanter and in line with the long axis of the neck of the femur. Separation of the symphysis pubis (which we consider under the heading of fractures because the symphysis is not a true articulation, but a cartilaginous union of bones) occurs in our series only in connection with other fractures and in severe injuries. In general the same is true of sacroiliac separations.

#### ETIOLOGY

According to available statistics fractures of the pelvis comprise approximately 2 per cent of all the fractures of the human skeletal system. There is, in our practice, a noticeable increase in their incidence in the last five years. Our experience is that pelvic bones are fractured usually through direct violence or indirect violence. Only a very few result from muscular action. Table II shows that falls were responsible in 11 cases, automobile accidents and crushing injuries in 9 cases each, and various other injuries in 4.

Unique in the literature are 2 cases reported by Steiner<sup>7</sup> in which spontaneous multiple fractures occurred in the pelvis of men of middle age, who for a number of years had been undernourished and had developed a starvation osteomalacia.

TABLE II  
ETIOLOGY OF PELVIC FRACTURES

Cause of Fracture	Case Number	Total	Per Cent
Falls	5, 8, 11, 14, 16, 18, 21, 23, 25, 32, 33	11	33 3
Auto accident	1, 2, 3, 4, 6, 7, 17, 28, 29	9	27 2
Crushing injury	9, 10, 15, 20, 22, 26, 27, 30, 31	9	27 2
Other injuries	12 Struck by foreign body 13 Jumped from burning bldg. 19 Knocked off truck 24 In falling elevator	4	12 1

of forceps and contracted pelvis. We have no experience with the two last-mentioned causes.

#### CLASSIFICATION

The following classification of pelvic fractures is suitable for the present discussion:

1. Fractures of the pubis. This is the most common variety and makes up 56 per cent of all the fractures in our series (Table III). Out of a total of 33 cases of

fractures of the pelvis 23, or 70 per cent, had fractured one or more rami. Of these, 9 fractured one ramus, 10 two rami, and

called double vertical fracture of Malgaigne (See Fig. 2). This fracture occurred twice in our series.

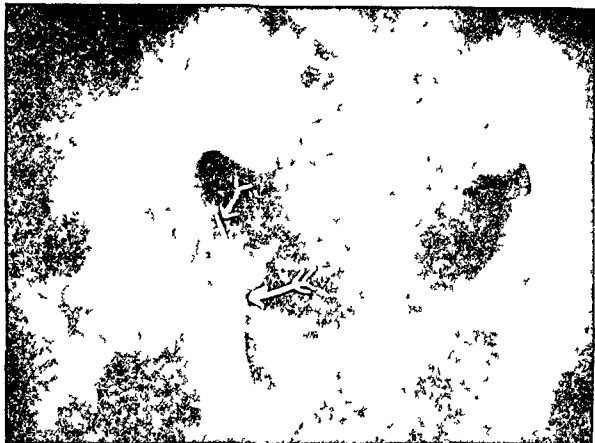


FIG. 3. Roentgenogram of Case XXV. Fractured acetabulum.

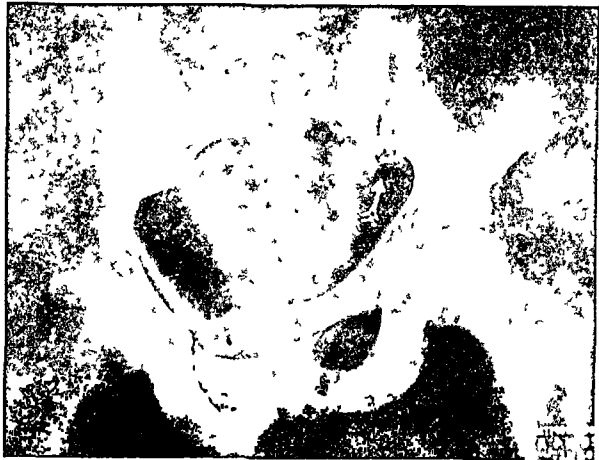


FIG. 4. Roentgenogram of Case XVII. Separation of sacroiliac synchondrosis and of symphysis pubis.

4 four rami of the pubic bone, making a total of 45 fractures of the pubis in a grand total of 80 fractures. Figure 1 illustrates this type of fracture.

TABLE III  
SUMMARY OF PELVIC FRACTURES

Bones Involved	Cases	Total Cases	Total Fractures	Per Cent of All Cases	Per Cent of All Fractures
Pubis					
One ramus	3, 4, 5, 8, 11, 21, 23, 24, 33	9	9	27.2	
Two rami	1, 7, 9, 10, 13, 16, 18, 22, 27, 29	10	20	30.3	
Three rami	0	0	0	0	
Four rami	12, 28, 30, 31	4	16	12.1	
		23	45	69.7	56.25
Ischium					
One ramus	4, 5, 6, 8, 11, 15, 23	7	7	21.2	
Two rami	7	1	2	3.0	
		8	9	24.2	11.2
Ilium	4, 11, 14, 19, 21, 25, 29, 32	8	8	24.2	10.0
Pubic separation	10, 11, 13, 17, 20, 23, 27	7	7	21.2	8.5
Sacrum	11, 18, 20, 26, 33	5	5	15.1	6.2
Acetabulum	2, 22, 23, 25	4	4	12.1	5.0
Sacroiliac separation	3, 17	2	2	6.0	2.5

3. Fractures involving the acetabulum. This fracture was present in 4 of our patients. It is the type referred to by Sever<sup>5</sup> as the most disabling of all pelvic fractures, especially when complicated by central dislocation of the head of the femur. (Fig. 3.)

4. Separation of the symphysis pubis or of the sacroiliac articulation. These conditions occurred in association with other fractures usually. In case XVII both of these separations occurred without any other fracture. In our series there were 7 pubic and 2 sacroiliac separations. (See Fig. 4.) The degree of separation may vary from an almost imperceptible distance to several inches.

5. Fractures of the sacrum or of the ischium. These occur in severe injuries and usually accompany other fractures of the pelvis. The ischium was fractured in 8 patients, one of whom had both sides involved, while the sacrum was broken 5 times. Only one such fracture was uncomplicated by other fractures. Two of the sacral fractures were due to falls on the buttocks and both developed postsacral hematomas, one of which was estimated to contain as much as 500 c.c. of blood. The question of shortening the con-

2. Fractures of the pubis with fracture of the ilium just posterior to the acetabular cavity or near the sacroiliac joint, the so-

valescence by aspiration came up but was rejected because of the danger of secondary infection. Both hematomas slowly ab-

which adds gravity to an already serious condition.

2. Pain is usually complained of by the



FIG. 5. Roentgenogram of Case XVIII. Fractured sacrum.



FIG. 6. Roentgenogram of Case XIX. Isolated fracture of ilium.

sorbed spontaneously, leaving no trace behind. (Fig. 5.)

6. Isolated fractures of the ilium. This type occurred eight times in our series and is thus not uncommon. It is not of great importance because usually the pelvic girdle is left intact. (Fig. 6.)

Fractures of the pelvis may be complete or incomplete. Most often a complete fracture is accompanied by considerable displacement and overriding of the fragments. This is especially true in the fracture of Malgaigne and in other double vertical fractures. When all four of the pubic bones are broken through there is formed a disconnected fragment lying anteriorly, often markedly displaced. Extensive splintering of the bones is quite common and often accompanied by penetration of the soft tissues by the splinters. Tears occur which involve the pelvic viscera. No instance of compound fracture of the pelvis has come to our notice.

#### DIAGNOSIS

The diagnosis of pelvic fracture is often overlooked, especially when other fractures have taken place concomitantly. It can usually be made on the following points:

1. There is a history of a severe injury, followed in many cases by profound shock

patient. It can also be elicited by compressing the iliac crests, by flexing the thigh on the abdomen, or by backward pressure on the anterior superior iliac spines when the patient is in the recumbent position.

3. Loss of function is especially marked if the fracture is at all extensive. There is great difficulty in standing and walking.

4. The signs of local trauma vary with the location and the extent of the fracture. Ecchymosis and discoloration in the perineum should lead one to suspect fracture of the pubis. Similar signs over the buttocks should lead one to careful examination of the sacrum.

5. Crepitus is easily elicited, especially where the ilium or the pubis is involved. This method of investigation must, however, be indulged in sparingly.

6. Deformity is sometimes discernible with difficulty, especially in thickset patients. In spare persons marked asymmetry may be detected at a glance. This is especially easy when the pubic bones are fractured, or when there is a separation of the symphysis pubis. In central fracture dislocation of the acetabulum with inward displacement of the head of the femur through the acetabulum a decided lessening of the trochanteric prominence is evident.

On rectal or vaginal examination the head of the femur may be revealed in the true pelvis.

7. Measurements. These usually confirm the appearance of the asymmetry or deformity; the most reliable measurements being those from the umbilicus to the anterior superior iliac spines.

8. Preternatural mobility can often be elicited by grasping the anterior superior spines in the palms of the hands and exerting pressure directly backwards. In many cases grasping one leg and moving it with an alternate pushing and pulling motion will reveal movement of the fractured parts.

9. A vaginal or rectal examination should both be made where any doubt exists as to the possibility of isolated fractures of the sacrum, coccyx, or ischium. The method of Lewin<sup>3</sup> is to insert the index finger into the rectum and palpate the coccyx and the sacrum between that finger and the thumb. Abnormal mobility and crepitus are easily detected. Thus is furnished also sometimes the first evidence of severe injury to the pelvic organs.

10. A roentgenological examination is of paramount importance in all cases, for a considerable number of the fractures of the pelvis escape recognition otherwise until sometime following the injury. The symptoms may be masked by shock, or the surgeon's attention may be drawn to other simultaneously produced injuries, such as fractured ribs or vertebrae. It is very significant from the medico-legal aspect that one get visual demonstration of the pelvic bones to establish evidence as to possible fractures. It is a curious fact that the absorption of bone along a linear fracture will often serve to increase the contrast in a picture taken two or three weeks after the injury and to make the line of fracture easy of demonstration. For that reason it may become necessary, in doubtful cases, to take a second radiogram about three weeks after the injury. One should not forget in examining x-ray films that occult spina bifida and other

congenital deformities are comparatively common conditions, and should, therefore, be recorded at the first examination, because such abnormalities serve as a basis for unfair claims by unscrupulous damage-seeking litigators.

#### TREATMENT

The transportation and movement of patients with fractures of the pelvis must be done with the greatest care, both on account of the shock already present and for fear of producing or increasing visceral injury. In all instances the patient should be transported in an ambulance to a hospital after first aid has been given in the form of a wide moderately firm bandage around the pelvis to immobilize it. The knees may likewise be tied together to steady the broken parts.

After the patient is placed flat in bed shock demands the first consideration, and a complete physical examination is made at once.

If there is bleeding from the urethra or from the rectum the source of such hemorrhage is established at once. The patient is warned against passing the urine for fear of pelvic extravasation. It has been our practice to pass a sterile soft rubber catheter at once in order to avoid this, and if blood comes from the urethra the catheter is fixed in place. Failing to pass a catheter usually implies serious laceration of the urethra and suitable operative treatment is demanded.

It is rarely necessary to make elaborate attempts at reduction of the fractured fragments, for, as a rule, they tend to reduce themselves after the patient is placed flat on his back. Where there is an upward displacement of the acetabulum on one side extension should be applied in order to avoid shortening. We use only enough weight to counterbalance the muscular pull, as this is enough to cause a gradual replacement of the fragments to a more or less normal position. In women of the childbearing age the potential complication of narrowing of the pelvic

outlet must be kept in mind and an attempt made at proper reduction. Overriding of fragments of the pubis can

about nor work away from their proper locations. The legs are now abducted far enough to form an angle of about



FIG. 7. Fronto-distal view of plaster-of-Paris case applied for fracture of pelvis.

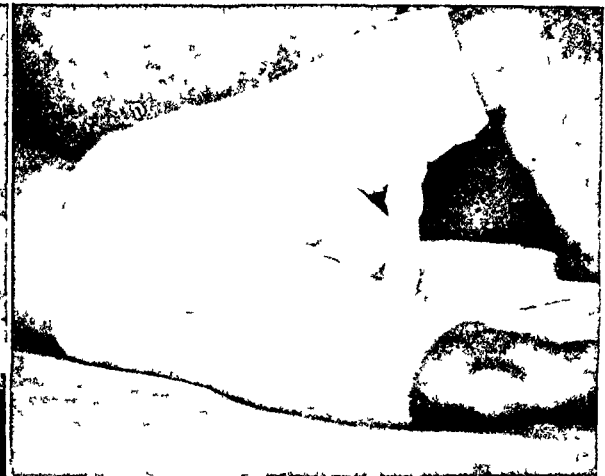


FIG. 8. Anterolateral view of plaster-of-Paris case applied for fracture of pelvis. Pictures taken about four weeks after application.

often be easily corrected by simple manipulation with one or two fingers in the rectum or vagina.

The essential principle to be kept in mind in the treatment is immobilization. This was secured in Westerborn's<sup>8</sup> cases by bed rest with or without a girdle or sling. We have found plaster-of-Paris cases of the body extending from the umbilicus to the middle of the thighs the most satisfactory method. They are especially comfortable and give complete safety to the patient who must be turned and lifted for baths and other toilet necessities. Our practice is to wait from one to several days for the patient to overcome his shock and to secure reposition of the fragments by extension and traction. After that he is placed on a fracture table and supported on the sacral saddle. Next to the skin is placed the usual stockinet and this covered by a well-applied dressing of several layers of cotton wadding, fastened down by a turn or two of gauze bandage. Felt pads are next placed over the bony prominences of the sacrum, the iliac crests and spines, and the trochanters. These felt pads are fixed in place by the first few turns of plaster-of-Paris bandages, so that they will not slide

30° with each other, and the plaster-of-Paris is applied. A cross-bar is fixed between the thighs to facilitate handling and turning of the patient in his bed. Figures 7 and 8 show the appearance of such a case when finished and dried. In some patients it may be necessary to leave the extension on the leg and apply the plaster case over it, later resuming the traction. Where the symphysis is widely separated, or where the sacrum is fractured, it is well to put on the case with the patient suspended in a sling rather than to make use of the sacral rest on the fracture table. No anesthetic is required for application of a plaster case. After four to six weeks the case is removed, but the patient is kept in bed for several weeks more in the severer cases. The actual stay in the hospital varies greatly according to the extent of the fracture, and also according to the type of personal care demanded by the patient. In our series the smallest number of days spent in the hospital after the injury is one, the greatest 112, the average 43 (See Table 1).

In those cases where multiple incisions of the perineum or a suprapubic cystotomy may become necessary we place the patient

on a simple rectangular frame over which two sheets of canvas are tightly stretched, so as to leave a 7 inch gap between them running across the middle of the frame. When the patient's buttocks are placed into this gap the pelvis is given more or less fixation, which can be easily augmented by a tight band from side to side of the frame over the top of the symphysis. Such a frame is very satisfactory also from the point of view of sanitation and the care of urinary drainage.

There are few, if any, indications for open reduction of fractures of the pelvis. Wiring and suturing of the symphysis pubis have been recommended, but we have not had occasion to do this. Fracture of the coccyx may be followed by continued pain. In those cases the bone should be removed.

For central fracture dislocation of the head of the femur and acetabulum we consider the method of Whitman<sup>9</sup> the procedure of choice. Fixation of the pelvis is secured by full abduction of the intact leg, after which sufficient abduction of the involved leg will stem the trochanter against the upper acetabular border and rotate the head of the femur down and out into its normal position. The usual case is applied for immobilization and also moderate traction to overcome the muscle pull. This method is also advocated by Eliason and Wright<sup>2</sup> who report a series of 15 cases, some of which were of severer degree of deformity than any of ours. The method of skeletal traction used by Putti,<sup>4</sup> who drives a steel pin through the trochanter, we think is too elaborate and opens avenues for infection of the bones. We have not experimented with it.

#### COMPLICATIONS

In our experience the most common complication of fracture of the pelvis is rupture of the pelvic viscera. In 7 cases, or 21 per cent, there was laceration of the urethra, rupture of the bladder, or tearing of the rectum, with subsequent fistula formation in 2, or 6 per cent. Both of these

we demonstrated definitely by the injection of dye solutions, and, what is more interesting, both eventually closed spontaneously. The visceral injuries accompanying pelvic fracture form the material for another paper and will not be discussed further here. (See Table iv.)

TABLE IV  
COMPLICATIONS OF PELVIC FRACTURES

Case	Complication	Treatment	Result
7	Ruptured urethra Ruptured bladder	Operation	Rectovesical fistula
9	Ruptured urethra Osteomyelitis of the pubis	Operation	Perineal urinary sinus and 75 per cent incapacitated
10	Ruptured urethra	Indwelling catheter	Complete recovery
16	Ruptured urethra bony spicule pierced bladder	Indwelling catheter	Complete recovery
18	Sacral hematoma	Rest	Complete recovery
20	Ruptured urethra	External urethrotomy	Complete recovery
23	Fract. vertebra	Rest	Complete recovery
25	Fractures of 6 vertebrae 6 ribs	Rib resection	Empyema
26	Sacral hematoma	Rest	Complete recovery
*29	Cerebral hemorr.		*Death
31	Ruptured urethra Ruptured rectum	Operation, trans-fusion	Satisfactory recovery
32	Fractures of clavicle and one rib	Rest, splint	Complete recovery
33	Ruptured urethra Fractures of three ribs	Indwelling catheter rest	Convalescent

\* Complication not due to pelvic fracture.

Concomitant fractures elsewhere in the body were present four times (12 per cent) and became a very serious factor in one instance. Case xxv fractured a number of transverse vertebral processes and six ribs on one side. A hemothorax developed and later an empyema, which had to be drained by rib-resection. The patient, eighteen months after the injury, is still incapacitated, not from the pelvic fracture but from the complicating fractures of the ribs. Case xxxiii had three fractured ribs, and cases xxiii and xxxii a fractured lumbar vertebra and clavicle, respectively. All proceeded to uneventful recovery. Westerborn<sup>8</sup> states that these two complications are the most common in his

series, 30 per cent being complicated by other fractures and 16 per cent by rupture of a pelvic viscus.

Postsacral hematoma was present in cases XVIII and XXVI. Both absorbed spontaneously without special treatment.

Osteomyelitis of the pubis occurred in one case following extravasation of urine. A perineal urinary sinus existed for several months but eventually closed spontaneously.

Case XXIX was an old man with generalized atherosclerosis in an advanced degree. He died of a cerebral hemorrhage (substantiated at autopsy) a few days after leaving his bed. It is probably safe to state that this condition was not a true complication of his pelvic fractures.

Two complications with which we have no experience are fat embolism and injury of the sacral plexus.

#### PROGNOSIS

We find that uncomplicated and properly treated pelvic fractures proceed to complete recovery in the vast majority of cases. A protracted convalescence or permanent disability are usually due to complications. Westerborn<sup>8</sup> reports that 93 per cent are restored without marked incapacity. In our experience 85 per cent are free from disability, while 15 per cent are more or less permanently incapacitated. The ultimate results in 5 of our cases are not known to us. We have reason to believe, however, that they are entirely satisfactory, since the extent of their injuries was of the less serious nature and no complications were present in any of them.

A word of explanation is probably necessary here. It is our custom to regard a patient as free from permanent disability if he is able to return to his former occupation or one similar in nature. Thus it becomes obvious that a patient completely restored functionally may show some slight anatomical changes which we have here disregarded. Ability to perform his usual daily work is the criterion of our

results. This seems to us the fairest basis upon which to estimate the final consequences, since all but 5 of our patients are workers active in some industrial occupation.

A few outstanding points of the material here presented are of interest. (Tables I and III.) The ages range from 16 to 72 years; average age being 40 years. There are 6 females and 27 males. The left side alone is involved 13 times (39 per cent); the right 10 (30 per cent); both sides 10 times (30 per cent). The smallest number of fractures in one patient is 1; the greatest 5; the average 2.42. The total number of fractures in all 33 cases (not including complicating fractures) is 80. Eight patients have a single fracture (24 per cent); 11 have 2 (33 per cent); 7 have 3 (21 per cent); 6 have 4 (18 per cent); and 1 has 5 fractures (3 per cent). The greatest number of days of treatment before final discharge is 305; the least 35; the average 95 days.

#### SUMMARY AND CONCLUSIONS

1. Pelvic fractures are the result of severe injuries, most common of which are falls automobile accidents, and crushing injuries.

2. There is a gradual increase in the incidence of pelvic fractures in the last few years.

3. The most common site of fracture is the pubis.

4. Conservative treatment should be in order unless definite operative indications present themselves.

5. Injuries of the urethra and bladder are the most common complications.

6. The most serious factors are not the fractures *per se* but the visceral complications.

7. Surgical shock usually accompanies fractures of the pelvis and should receive immediate and primary consideration.

8. Taken as a whole fractures of the pelvis offer a very favorable prognosis both as to life and as to function.

[For references see Author's reprints.]

# CYSTINE CALCULI

## REPORT OF THREE CASES\*

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TREATMENT of urinary calculi is always a tedious and difficult surgical problem because of the possibility of recurrence. The treatment of a patient with cystine stones is both medical and surgical, and even after resorting to every known remedy, we often find that we have failed. The greatest problem is not in the surgical removal of the stones, but in preventing their reformation which results in damage of the kidneys and impairment of renal function.

### HISTORY

In 1810 Wollasten<sup>55</sup> read a paper before the Royal Society of London "On cystic oxide, a new species of urinary calculus." He described two stones, one of which had been removed in 1805 from a boy five years of age and the other from a man of thirty-six. He called them cystic oxide since both had been removed from the bladder. Berzelius<sup>30</sup> in 1822 proposed the name cystine because the substance was found to be not an oxide. The first observations on patients were made by William Prout<sup>40</sup> in 1821 who described one with cystinuria and one with a cystine bladder stone. Lassaigne<sup>22</sup> in 1823 found a cystine stone in the bladder of a dog. Baudrimont and Malagutti<sup>30</sup> in 1837 discovered that cystine contained sulphur but Thaulow<sup>47</sup> in 1838 was the first to determine the correct chemical formula.

As early as 1840 William Prout<sup>40</sup> states that the cystic oxide disease is of an hereditary character and occurs in members of the same family. He also points out that the peculiar composition of cystic oxide shows that its formation results from an imperfect assimilation of the albuminous principle and seems to be a peculiar form of hepatic disease. Strangely

enough this corresponds very closely to our modern conception of the disease. Dewar and Gamgee<sup>13</sup> in 1901 discovered cystine in the sweat. Drechsel and Cloetta<sup>9</sup> found cystine in the liver of a horse and in the kidney of an ox. Spiegel<sup>18</sup> in 1901 proved that cystine was an intermediary product of protein metabolism. Cystine was produced from horn and hair synthetically by Embden,<sup>16</sup> and by the hydrolysis of keratine by Morner.<sup>36</sup>

Udranszky and Baumann<sup>49</sup> in 1889 believed there was some connection between cystine diseases and intestinal putrefaction. Another theory of the origin of cystine in the urine brought forth by Stadthagen and Brieger<sup>45</sup> says that it is caused by an intestinal mycosis because of the presence of certain diamines in the urine and feces of cystinurics.

In 1856 Thoel<sup>48</sup> showed the familial occurrence of cystine by finding it in several members of the same family. Charles A. Simon<sup>18</sup> in 1900 collected from literature 103 cases of cystine stones.

### DESCRIPTION

Cystine chemically is a very complicated organic compound. It belongs to the group of amino-acids, being the only one which contains sulphur. Its sulphur content is about 25 per cent.

Cystine is absolutely necessary for the growth of the body. Feeding experiments on rats and dogs have shown that cystine is an essential amino-acid and hence necessary in the diet if growth and maintenance of body weight is desired. Cystine and cysteine cannot be synthesized in the body.<sup>38</sup> Some cystine, however, is stored in the muscles and is called endogenous cystine, in contradistinction to the exogenous cystine which is utilized directly

\* Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, May 15, 1929.



from the food protein. Lewis and Lough<sup>24</sup> believe that the ingested cystine is properly assimilated and utilized by the body and

of cystine. The Chinese edible birds' nests, which are formed by the mucin-like salivary secretion of these birds, contain the



FIG. 1.



FIG. 2.

that cystinuria is the result of improper catabolism and thus almost entirely endogenous in origin. They failed to find any appreciable difference in the excretion of cystine on a high or low protein diet even when cystine itself was added. An experiment by Robson<sup>41</sup> showed that the average cystine excretion on a high and low protein diet varied from 1.1 gm. to 0.71 gm., and concludes that the cystine excretion is in almost direct ratio to the protein in the diet. Further experiments have shown that neither cysteinic acid, taurine, or any other substance is capable of replacing cystine.<sup>23</sup>

Since cystine is an indispensable essential amino-acid and growth is limited by a low cystine diet, we would expect a high cystine content in food which is most important for infant feeding. Thus the lactalbumin of milk contains 4.5 per cent

greatest amount of cystine.<sup>52</sup> All proteins contain some cystine but the amount varies considerably. Milk, nuts, beans, whole wheat bread, rye, eggs, oats and meat contain much cystine, while corn, gelatin, cheese, lentils, peas, cow-peas, and red kidney beans contain much smaller amounts.<sup>56</sup> Fish contains less cystine than any other meat.

It was formerly believed that normal urine contained no cystine. According to investigations by Looney,<sup>57</sup> slight traces may be found in normal urine averaging about 4 mg. in 100 c.c. of urine. This corresponds approximately to one-third the amount one finds in the urine of a cystinuric. Cystine crystals, however, are not found in normal urine but only appear after this limit is exceeded.

Cystine occurs in cystinuria as hexagonal, colorless, highly refractive crystals, occa-

sionally in the form of needles. Cystine stones are of a honey-yellow, waxy appearance. They have a somewhat crystallized appearance and a peculiar semitransparent luster. They may be very small or large enough to completely fill the kidney pelvis. These stones may be purely cystine but are often mixed with other salts. Pure cystine stones have no distinct laminae, but appear as a mass confusedly crystallized.

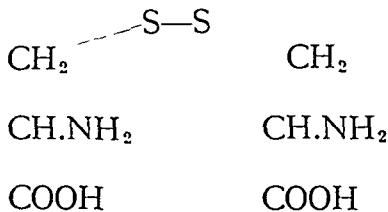
There are three methods of determining the amount of cystine: (1) gravimetric (Gaskell<sup>17</sup>); (2) polarimetric (Magnus-Levy<sup>33</sup>); and (3) colorimetric (Looney<sup>57</sup>). Cystine is readily soluble in alkalis but not in alcohol, acids or water. It decomposes readily in the urine.

F. W. Wards in 1923 published some very interesting experiments in which he shows that cystine is the only amino-acid that has any marked absorption of ultra-violet light. He says:

It would appear suggestive that the presence of cystine in hair and wool (where the concentration approaches 10 per cent) is of physiological importance in the protection of the organism against the harmful effects of prolonged exposure to sunlight. The curious custom of the Arabs in wearing heavy but loosely fitting woolen clothes has apparently a strong justification in the protective effect of the cystine present in the wool.

#### CHEMISTRY

The chemical formula of cystine according to Friedman and Neuberg<sup>30</sup> is:



By oxidation this is split into two molecules of cysteinic acid. These products of cystine are stored in the blood cells, liver, and tissues, and hold the oxygen in various parts of the body for use. Hence they regulate the equilibrium between the oxidants and reductants of the cells.

Cystine and tyrosine have been isolated from hydrolyzed crystalline insulin, proving the presence of these amino-acids in

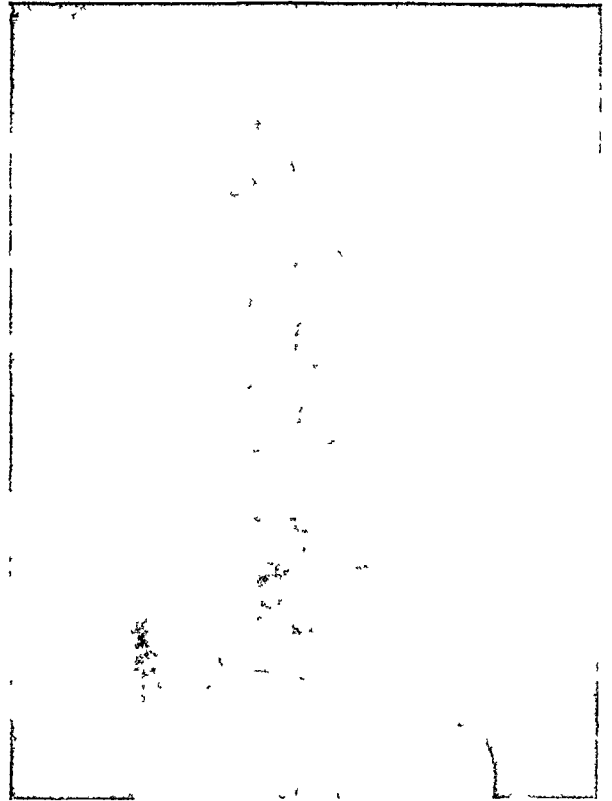


FIG. 3.

the "insulin molecule."<sup>51</sup> Cystine is a derivative of insulin in which cystine is probably linked to the rest of the molecule by a peptide linkage.

#### TOXICITY

The toxic action of large doses of cystine has experimentally been proved by many workers. Lignac<sup>28</sup> in 1925 found severe tubular injury of the kidneys in mice from the subcutaneous injection of a suspension of cystine. H. B. Lewis<sup>26</sup> in 1925 fed cystine to rabbits and produced similar injuries to the kidneys. Curtis and Newburgh<sup>58</sup> in 1927 reached the following conclusions from experiments on white rats: (1) An 8 per cent casein diet does not contain sufficient cystine to permit good growth. (2) The basic diet of 18 per cent casein contains sufficient cystine for growth. (3) Cystine in the diet becomes harmful when it contains roughly two and a half

times the requirement and with increasing amounts of cystine the injurious effects become more and more severe. A 5 per cent

other respect. Many individuals who excrete large amounts of cystine go through life with out any difficulties, and it is only

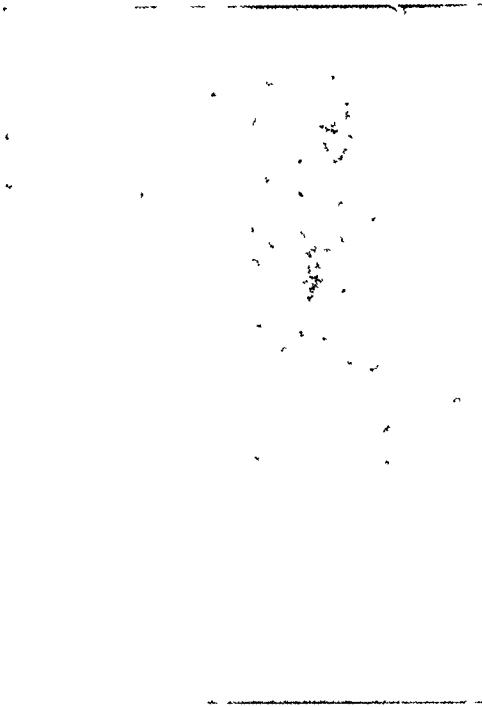


FIG. 4.

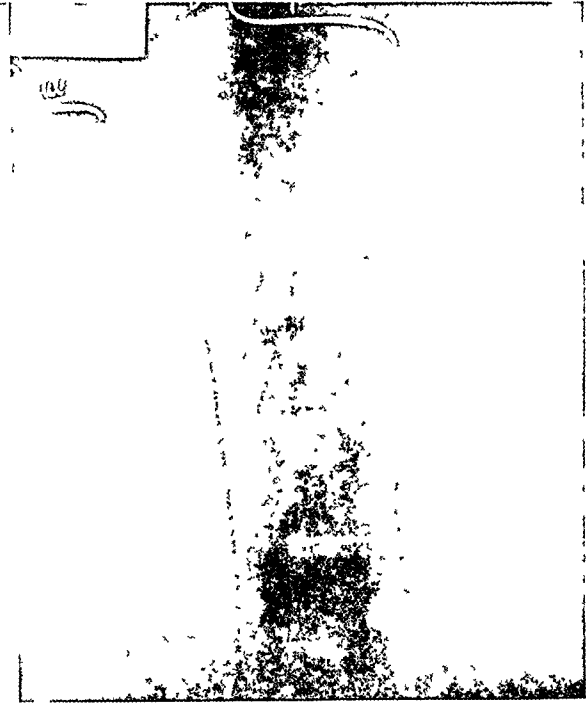


FIG. 5.

addition of cystine works as a powerful poison and 10 per cent kills the rats in a few days, causing a diffuse hemorrhagic necrosis of the renal parenchyma.

Cystine also exerts a toxic action on the liver when large doses are administered. A complete necrosis of the liver is caused in four days by adding 20 per cent cystine to the diet.

Cystine apparently exerts no toxic effect in cystinuric patients except rarely in very young children where metabolic disorders are extremely severe. Abderhalden<sup>1</sup> and Lignac<sup>29</sup> have reported autopsies on four children who died from inanition in which cystine was found in most of the internal organs. The body requires, or can use, a certain amount of cystine and only a portion of the cystine from the ingested protein is excreted as such, the remainder being used by the body in the normal manner. The metabolism of cystinuric patients apparently suffers no other abnormality. They are usually well developed and entirely normal in every

when calculi are formed in the urinary tract that symptoms occur. Watson and Cunningham<sup>46</sup> report 1 stone-forming patient in 32 cystinurics, Morris<sup>37</sup> 2 in 77 cystinurics, and Sir Henry Thompson reports 3 in 114 patients excreting cystine. Thus only 2.5 per cent of cystinuria cases form stones. About 70 per cent of the reported cases are in males.

Alsberg and Folin<sup>3</sup> have proved that the amount of cystine excreted in the urine in a case of cystinuria varied directly with the amount of protein consumed. From 30 to 50 gm. of protein per day is the minimum for normal metabolism, and this amount causes considerable cystine excretion.

#### SYMPTOMS

It is an interesting feature of cystinurics that they often reveal a history of passing stones sometimes for many decades with only slight transient symptoms. Usually the first symptom noted is renal colic with or without the passage of a stone with hematuria. General malaise or a feeling of

weight in the loins is not uncommon. An attack of renal colic may last from fifteen minutes to two or three weeks. Cystine crystals are usually found in the urine although cystine stones have been removed from the kidneys of patients whose urine never showed cystine crystals. MacAlpine<sup>32</sup> noted that the urine of cystinurics on decomposition had a foul odor, probably due to the sulphuretted hydrogen produced during the decomposition of cystine. A silver coin in the pocket of a cystinuric may turn black from the sulphur of the cystine present in the sweat.<sup>13</sup>

Cystine diathesis is an hereditary metabolic error. The youngest cystinuric reported was a baby of ten and one-half months and the oldest a man of eighty-one years.<sup>30</sup> This latter patient had never had alarming symptoms although he had passed stones for over thirty years. Cystinuria may be transitory or it may persist throughout life. It often occurs in many members of the same family. Poland, Stras-ser, Morner,<sup>36</sup> Cohn,<sup>10</sup> Pfeifer,<sup>39</sup> Marcet, Civiale, Thoenel,<sup>48</sup> Golding-Bird, Hatuier, Ebstein,<sup>14</sup> Lichtenstein,<sup>27</sup> Kretschmer<sup>21</sup> and others have all reported more than one case in the same family.<sup>30</sup>

Cystine stones may be located anywhere along the urogenital system: urethra, prostate gland, bladder, ureter, kidney pelvis, or renal parenchyma. Nothing can be said of the frequency of their location, as only recently with the development of cystoscopic and x-ray examinations has it been possible to locate them accurately. They are more liable to be multiple than single. Schottmueller<sup>43</sup> and Edwards<sup>15</sup> have reported cases with more than one hundred stones.

Cystine has also been found outside the urinary tract. Mueller<sup>21</sup> reported cystine in the blood in a stubborn case of urticaria; Umber and Burger,<sup>50</sup> in the muscle; Sherer, in the liver; and in the mesentery and other internal organs by Abderhalden<sup>1</sup> and Lignac.<sup>29</sup> Cystine may occur in the urine in phosphorous poisoning, tuberculosis or syphilis.

There is considerable difference of opinion regarding the x-ray shadows cast by cystine stones. Kuemmell<sup>6</sup> states very

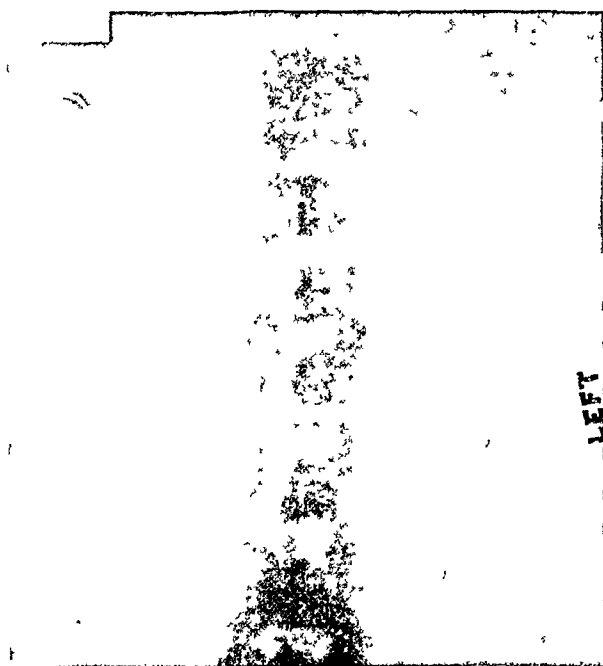


FIG. 6.

definitely that cystine stones do not throw an x-ray shadow. In a case reported by E. Beer<sup>6</sup> the x-ray showed the large stones but not the smaller ones. Graves says that cystine stones should not cast an x-ray shadow while Thomson-Walker<sup>46</sup> state that cystine and xanthine give shadows almost as dense as calcium phosphate. Mueller and Stallman reported cases which cast good shadows with the x-ray. Morris<sup>37</sup> states that many cystine calculi contain calcium phosphate or magnesium and ammonium phosphate, but that cystine contains from 25 per cent to 75 per cent sulphur and therefore should cast a very deep shadow. Winsbury White<sup>54</sup> states that cystine and xanthine give poor shadows when in the pure state but of slightly more opacity than those of urates, uric acid, and triple phosphates, because of the sulphur they contain.

#### TREATMENT

The oldest and still the most modern treatment of cystine calculi is the internal administration of alkalis. Both Cantani<sup>8</sup>

in 1881 and then Beale<sup>5</sup> (in 1884) advised large doses of ammonium carbonate and successfully treated their patients in this

similar chemical compounds failed completely.

Edwards<sup>15</sup> advises the use of choleic

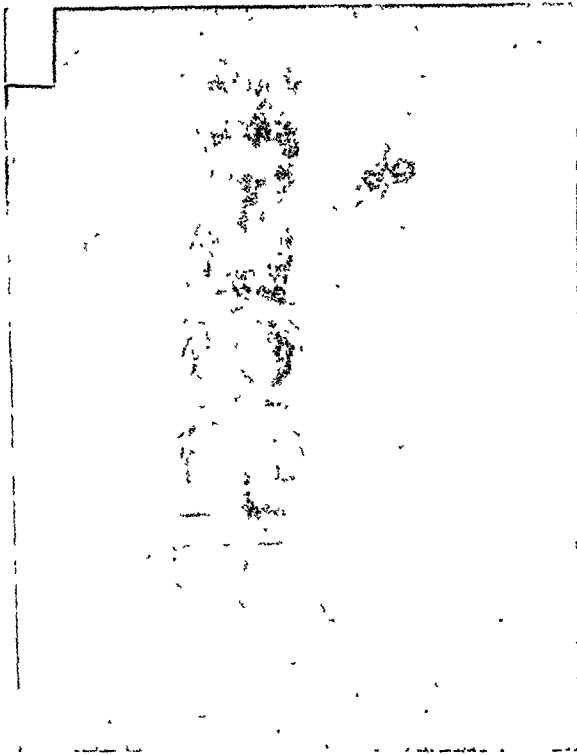


FIG. 7.



FIG. 8.

manner. In 1914 Jacobi and Klemperer<sup>19</sup> strongly recommended the alkalinization of the urine with 10 gm. of sodium bicarbonate.

Looney found that the neutral sulphur in the urine remained unchanged regardless of the amount of alkalis given and therefore believes that the cystine was merely in solution and not actually decreased in amount. Smillie<sup>44</sup> demonstrated a decrease in the sediment in an alkaline urine but not in the amount of cystine excreted.

Crowell<sup>11</sup> in 1924 described a case where he succeeded in disintegrating kidney stones and keeping the urine free from cystine by the internal administration of alkalis.

Klemperer<sup>19</sup> and Smillie<sup>44</sup> advocated about the same treatment which consists in the oral administration of 6-10 gm. of sodium bicarbonate daily and a low protein diet. Every attempt to eliminate cystine from the diet by adding very

acid on the hypothesis that endogenous cystine is excreted because of the lack of choleic acid with which it should normally conjugate to become the taurine of the bile salts. This has proved of no benefit. He also suggests intestinal and urinary antiseptics to allay the pelvic infection which furnishes the irreversible colloid that glues the crystals into calculi. Vaccines have been of no benefit.

#### DIAGNOSIS

The diagnosis of cystinuria is made by finding cystine crystals in the urine. If a stone is discovered along the urinary tract and no cystine crystals are present in the urine, a diagnosis of cystine calculi cannot be made until the stone is removed. The appearance of cystine stones is characteristic. The history of repeated passing of stones is suspicious of cystine calculi.

#### CASE REPORTS

The following reports concern three

cases presenting cystinuria and cystine calculi:

CASE 1. D. E., a man, aged twenty-nine, was admitted to the Brady Urological Foundation of the New York Hospital February 28, 1927 with a right kidney stone. He complained of pain in the back, hematuria, frequent and urgent urination, and passing of small stones for the past ten years. One brother had previously been operated upon for a cystine stone in the bladder. The remainder of the family had no cystine in their urine and no history of stones. He had been perfectly well and robust with no previous illnesses except that his appendix has been removed ten years previously as a result of the first renal attack. He had passed about 50 small stones which were all soft and easily powdered when dry. A renal colic began with a feeling of depression, followed by hematuria and pain in either the right or left back lasting from four days to seven weeks and ending by the passage of small stones.

Physical examination was entirely normal except for slight tenderness in both right and left costovertebral angles. Urine analysis showed a trace of albumin, sp. gr. 1.021, with blood, pus, and cystine crystals. Blood chemistry:

Coagulation time	4 min.
Urea nitrogen	14 mg. per 100 c.c. of blood
Blood sugar	0.118 per cent
Plasma combining power	(CO <sub>2</sub> tension) 65 vols. per cent

Previous cystoscopy on February 9 revealed a normal bladder and ureters through which No. 6 F. x-ray catheters passed to the kidneys without difficulty. Kidney function revealed:

	Rt.	Left
Urea	$\frac{4}{5}$ gm. per l.	$5\frac{3}{5}$ gm. per l.
P.S.P. . .	App. 6 min.	3 min.
Per cent 10 min	2 per cent	13 per cent
Microscopic	8 w.b.c. per field	Blood
Cultures	Sterile	Sterile

X-ray showed large right and left kidneys in good position with a stone the size of the end of one's thumb in the right kidney pelvis. (Figs. 1 and 2.) A pyelotomy was done March 1, no sutures being used in the kidney pelvis. Recovery was uneventful.

The stone was oval and flattened, measuring  $9.5 \times 15 \times 21$  mm. It was rather hard in

consistency and when broken it was seen to be made up of light brown translucent large "granules," composed of cystine.



FIG 9.

He was next seen June 25, 1927 when his right ureter was dilated. On February 23, 1928, he suffered an attack of right renal colic at which time his right ureter was dilated and a large group of cystine crystals were crushed in the bladder. On March 5, 1928, he had pain in his left flank and was unable to void. Catheterization of his bladder released no urine. The left ureter was dilated with a No. 8 F. catheter which released a continuous flow of urine for five minutes. The right ureter was dilated with No. 9 F. bougie on May 12, 1928, June 2, 1928, and June 16, 1928. He was not seen again until February 2, 1929 when he complained of pain in his left kidney region. At this time an attempt to pass a No. 9 F. bougie met an obstruction just below the left renal pelvis. On February 13, 1929, he suffered severe pain, but passed no stone and his urine showed no blood. An attempt to dilate the left ureter encountered an obstruction just above the ureteral orifice and another about half way up the ureter which could not be passed. An x-ray showed the right kidney pelvis almost completely filled with stones. (Fig. 3.) There was a questionable

shadow in the region of the left kidney pelvis, but none could be seen along the course of the ureter. Two small stones were passed on

Foundation of the New York Hospital November 22, 1928 with bilateral kidney stones.

She complained of pain in the right side

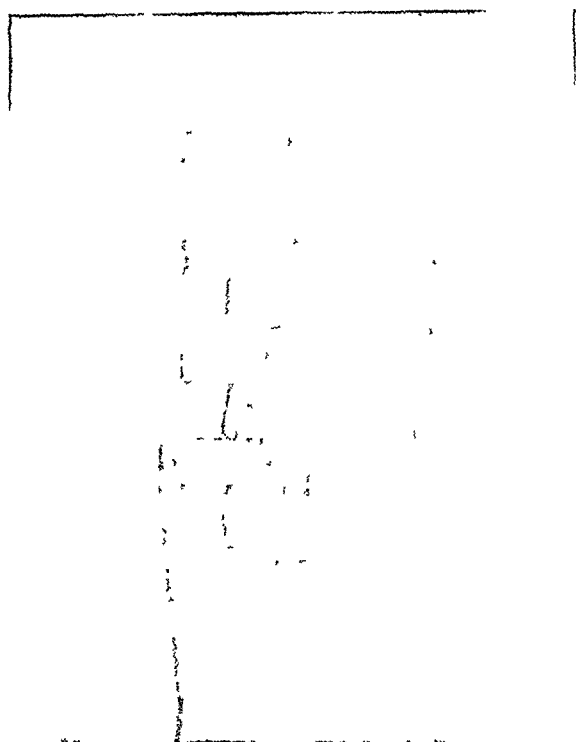


FIG. 10.

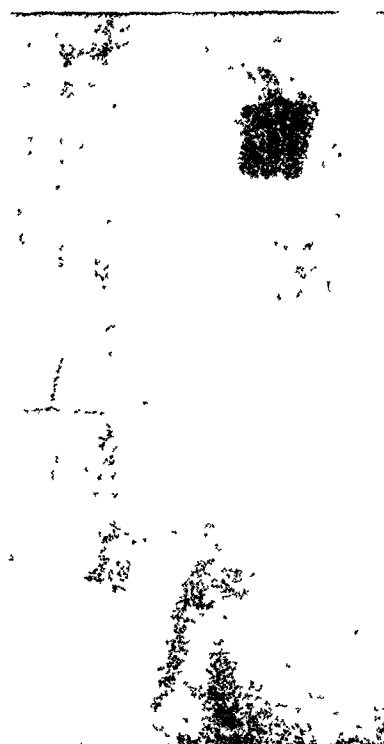


FIG. 11.

February 20, 1929 and one large one on April 27. On May 7, 1929 his urine showed a few W.B.C., rare R.B.C., few cystine, and many calcium oxalate crystals. He had taken various amounts of alkalis by mouth but has only been cooperative when in severe pain or urinary retention.

Cystoscopy May 10, 1929 revealed a slightly congested bladder. A No. 7 F. catheter passed to the right kidney easily but it was impossible to pass any catheter up the left ureter. A No. 6 F. bougie passed with difficulty almost to the left kidney. Kidney function showed:

	Rt.	Left
Urea.	5 mg. per l.	0.2 mg. per l.
P.S.P.	app. 5 min.	?
Per cent 10 min..	6.5 per cent	2 per cent
Microscopic	18 W.B.C. per H.P.F.	11 W.B.C. per H.P.F.
Cultures	Negative	Negative

X-rays on this date showed that the stones in the right kidney pelvis were somewhat larger in size.

CASE 11. E. P., a woman, aged thirty-seven, was admitted to the Brady Urological

and pit of her stomach with occasional attacks of renal colic accompanied by nausea and frequency of urination for a number of years. Her family history was irrelevant. During one of these attacks fourteen years ago her appendix was removed. Stones had been removed from both the right and left kidneys five years ago. She was comfortable for almost a year after these operations.

Physical examination revealed a well-nourished, apparently healthy woman with slight tenderness in the right costovertebral angle.

Urine analysis showed a trace of albumin, sp. gr. 1.012, with blood and pus.

Blood chemistry:

Urea nitrogen	11 mg. per 100 c.c. blood
Blood sugar	0.107 per cent
Plasma combining power	(CO <sub>2</sub> tension) 58 vols. per cent

November 22, 1928 Intramuscular P.S.P. 3 per cent—8 per cent—8 per cent—7 per cent—8 per cent. (Half hour specimens.)

Previous cystoscopy on November 1, 1928 revealed slight edema around the ureteral

orifices. No. 6 F. catheters passed easily to each kidney.

#### Kidney function:

	Rt.	Left
Urea.....	13 gm. per l.	8 gm. per l.
P.S.P.....	app. 9 min.	9 min.
Per cent 10 min....	2.5 per cent	2 per cent
Microscopic.....	pus 28 per H.P.F.	pus 2 per H.P.F.
Cultures.....	staphylococcus albus	sterile

X-ray plates showed large kidneys with many stones in each pelvis. It was deemed advisable to operate on the right side first because of pain and discomfort. (Fig. 7.)

A right nephrotomy was done November 23 with the removal of one large stone and several small ones. Recovery was uneventful.

Before the patient was discharged from the hospital an x-ray showed the complete absence of stones in her right kidney. (Fig. 8.) She was instructed to take 40 grains of sodium bicarbonate three times daily and to test her urine with litmus paper night and morning to be certain it remained alkaline. She was also advised to maintain a low protein diet and to return every two weeks to have her kidney pelvis lavaged. She has carried out none of these instructions and in all probability will form other stones in her right kidney.

CASE. III. S. H., a boy, aged sixteen, was first admitted to the New York Hospital on November 1, 1917 with pain in the right lower quadrant. This pain began one and one-half years previously with severe cramps which recurred at intervals. There was some tenderness over McBurney's point. His urine contained a few w.b.c. His appendix was removed.

On February 20, 1922 he was readmitted with pain in the left groin, having been awakened at night by a severe stabbing pain. He had some frequency of urination and an occasional w.b.c. in the urine. Cystoscopy revealed a colon bacillus pyelitis but x-rays and pyelograms showed no stones. Cystoscopy on February 25, 1924 revealed a calculus in the left kidney pelvis which was only apparent because of a filling defect in the pyelogram.

On admission February 25, 1924 he complained of recurrent attacks of renal colic and a heavy sensation in the kidney region with radiating pains to the penis.

Cystoscopy on this date revealed a patchy cystitis with some pus in the bladder. Catheters No. 6 F. passed to each kidney without difficulty. Kidney function:

	Rt.	Left
Urea.....	4 gm. per l.	3 gm. per l.
P.S.P.....	app. 4 min.	no app.
Per cent 10 min....	6 per cent	none
Microscopic.....	occ. w.b.c.	many w.b.c.
Blood urea nitrogen.	22 mg. per 100 c.c.	

Urine analysis showed a trace of albumin with much pus, occasional R.B.C., and cystine crystals.

On March 7, 1924 a left kidney stone was removed through a posterior pyelotomy incision. Small fragments of stone passed out through the wound during convalescence which was prolonged. Dilatation of the left ureter and a retention catheter to the kidney pelvis aided in healing the wound.

On March 28, 1924 a right pyelogram revealed a filling defect opposite the transverse process of the fourth lumbar vertebra. The patient received no further treatment until he was again admitted April 30, 1929. After he was discharged from the hospital in March, 1924, he had considerable pain in his right kidney region. In February 1925, a plain x-ray showed a large stone in the right kidney pelvis. For the next two years he had intermittent attacks of pain in both kidneys, but for the last two years he has had no pain except a feeling of weight in both loins. His only other symptom on admission was frequency of urination every hour. There has been no change in his weight.

Cystoscopy on April 30, 1929, showed a slight congestion of the bladder. No. 6 F. catheters passed to each kidney. Kidney function:

	Rt.	Left
Urea.....	10 gm. per l.	8½ gm. per l.
P.S.P.....	app. 13½ min.	app. 3½ min.
Per cent 10 min....	none	3½ per cent
Microscopic pus....	200 per H.P.F.	pus 200 per H.P.F.

Urine analysis showed a trace of albumin, sp. gr. 1.015 and much pus.

Blood chemistry: May 2, 1929: Urea nitrogen, 24 mg. per 100 c.c. Blood sugar, 0.113 per cent. May 6, 1929: Urea nitrogen, 19 mg. per 100 c.c. May 8, 1929: Urea nitrogen, 13 mg. per 100 c.c.

Plasma combining power (CO<sub>2</sub> tension) 59 vols. per cent.

X-rays taken April 30, 1929 showed multiple calculi in both kidneys as shown in the accompanying pictures. (Figs. 10 and 11.)

Confronted with such a difficult problem it was deemed advisable to do no surgery until we had attempted to dissolve the stones, or to prevent them from becoming larger.



If we could prevent the stones from increasing in size, we might then expect to keep the kidneys from forming new stones, providing

opened pain in both kidney regions and showed symptoms of alkalosis. All medication was stopped and the symptoms gradually subsided.

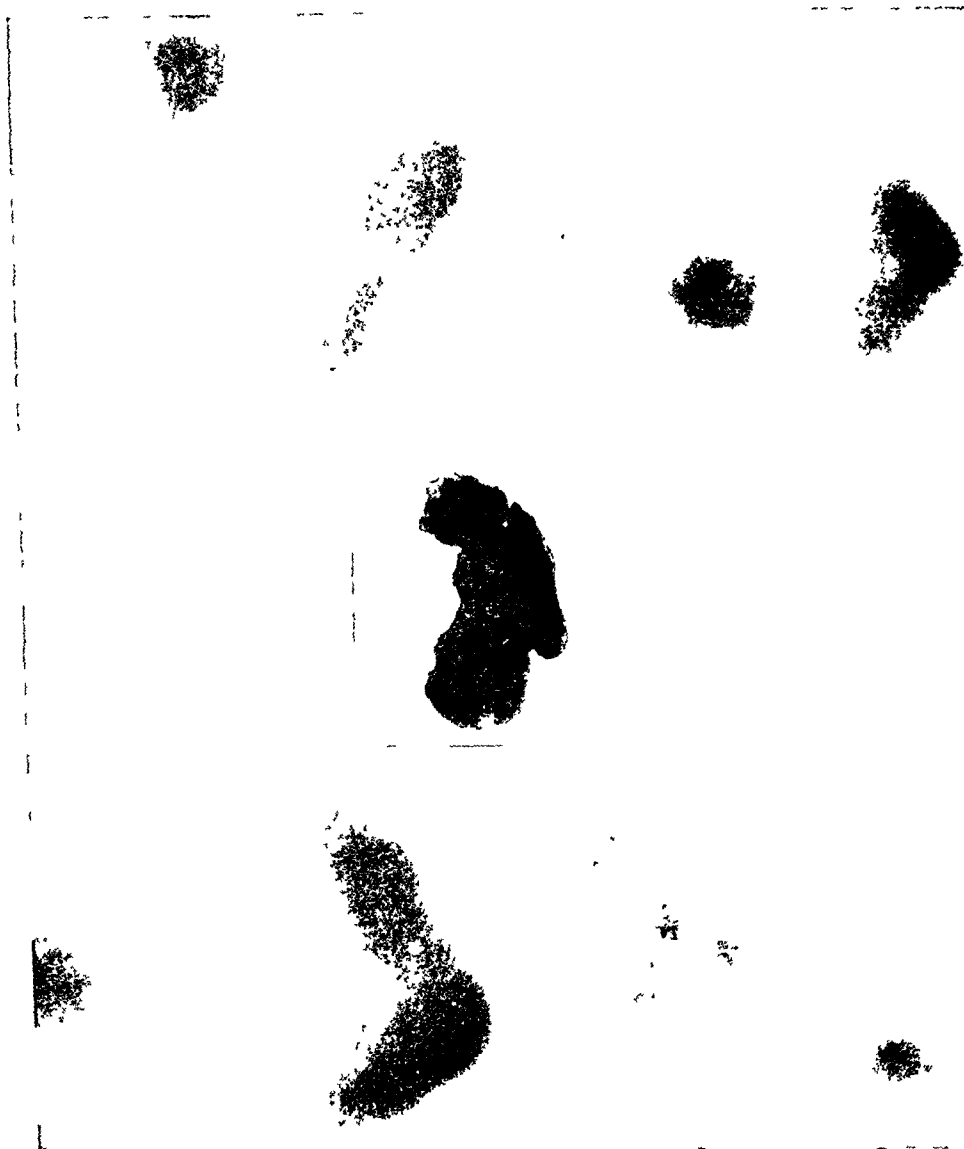


FIG. 12.

the patient lived up to a strict regime. Since cystine stones are soluble in alkalis, we administered large doses of sodium bicarbonate by mouth and irrigated one kidney pelvis with a solution of sodium bicarbonate.

On May 6, 1929, No. 6 and 7 F. catheters were both passed to the right kidney pelvis and left in position. Irrigation was begun through the smaller catheter with sodium bicarbonate solution every ten minutes, the solution draining from the kidney through the larger catheter. After ten hours the catheters stopped draining and were removed. Sixty grains of sodium bicarbonate was given by mouth four times daily. A low cystine diet was also given. On the third day the patient devel-

#### COMMENTS

The results in these 3 cases show how discouraging the usual treatment of cystine stones is. Surgical removal of the offending stone is merely the beginning of the cure of the patient.

Each of these patients had the appendix removed on account of attacks of right-sided pain. Then each had stones removed from one or both kidneys and promptly reformed larger stones with a resulting decrease in kidney function.

The first attack of renal colic was always on the right side. The most common

symptom was pain in the back with history of recurring attacks of renal colic over a considerable period of time. Hematuria has been present in each at one time or another, and a history of passing small stones in the urine is common. Frequency and urgency of urination is probably the result of the infection which is always present, and probably plays an important rôle in the formation of the stones.

Strangely enough the family history of each has been irrelevant and we have been unable to find cystinuria in any other member of the families except one brother of D. E. Each of the patients has had unusually good health all his life except for the formation of these cystine stones. There has been no venereal history in any of them.

Cytoscopic examinations have shown very little pathology in the bladder. Stones have either passed entirely, or have remained in the kidneys. A kidney containing a stone showed no function at one time, and after removal of this stone, this same kidney later on was doing all the work. Urine cultures have shown definite infection in each case. Blood chemistry examinations have been normal even when both kidneys were embarrassed with large stones. The longest expectancy for relief after surgery alone is one year.

Plain x-ray pictures have shown the stones in all cases eventually. However, in Case III, repeated x-ray and pyelograms failed to reveal the presence of a stone until it had reached considerable size. Even then the stone was first discovered by a filling defect in the pyelogram. Cystine has been variously estimated to contain from 25 to 75 per cent of sulphur. We have prepared an x-ray of a cystine stone, plain starch paste, and starch paste with 5, 15 and 25 per cent sulphur, to show the various densities obtained. (Fig. 12.) It is apparent that any stone containing 25 per cent sulphur should cast a shadow sufficient for diagnosis.

#### TREATMENT

Patients suffering from cystine calculi must be treated medically as well as

surgically. The preoperative diagnosis and the postoperative care are more important than the mere removal of the stone.

Before considering an operation, the condition of the ureter and kidney must be determined. An obstruction in the ureter or a ptosis of the kidney may be remedied at the time of operation. To expect the kidney to remain free from stones, one must be certain that good kidney drainage is established. If a stricture of the ureter is present it should be dilated. A nephropexy can be done on a ptosed kidney at the time the stones are removed. Chromic catgut should not be used in the kidney.

It has been established that cystine crystals are either dissolved or disintegrated in an alkaline media. Therefore sufficient sodium bicarbonate should be given to render the urine alkaline and keep it alkaline. The urine can easily be tested morning and night by the patient himself. Potassium bicarbonate, ammonium bicarbonate or other alkalies may be used if sodium bicarbonate is not well tolerated. Sixty grains of sodium bicarbonate three times daily is usually well tolerated and sufficient to keep the urine alkaline.

Infection of the kidneys must be combated. Urinary antiseptics which are active in alkaline urine should be given at intervals. Pyridium may be used for this purpose. Dilatation of the ureters and irrigation of the kidney pelvis with an antiseptic solution is of value.

The gastrointestinal tract should be carefully regulated. Salol may be given for one week of each month.

A low cystine diet should be adhered to. Some proteins contain much cystine and others very small amounts. Milk, nuts, beans, peas, bread, eggs, meat and fish contain large amounts of cystine and should never be permitted. Gelatine, cheese all fruits, all vegetables (except peas and beans), butter, cream, jellies and jams, corn bread or corn cereal (sparingly) contain small amounts of cystine, yet sufficient protein to maintain normal metabolism.

## CONCLUSIONS

1. Cystine calculi are medical as well as surgical problems.

2. Cystine stones recur so frequently and quickly that all means at our disposal should be used to prevent this. The probability of stones reforming should be impressed on the patient, who must cooperate in every respect.

3. Cystine stones usually cast a shadow in x-ray pictures. Small stones may cast no shadow.

4. Treatment consists of:

(1) Establishing perfect kidney drainage.

(2) Keeping the urine continuously alkaline.

(3) Urinary antiseptics.

(4) Ureteral dilatation and kidney pelvic lavage.

(5) Gastrointestinal antiseptics.

(6) Low cystine diet.

I wish to take this opportunity to thank Dr. Lowsley, Dr. Butterfield, and Dr. Seward Erdman for permitting me to report these cases. I also wish to thank Dr. Frederick B. Henschel for helping prepare this paper and for many helpful suggestions.

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# CANCER OF THE LIP AND BUCCAL MUCOUS MEMBRANE\*

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HAMLET, N. C.

**P**ROBABLY no field of malignancy has proved so hard to deal with successfully as that where the growth

dissection being made about  $\frac{1}{2}$  inch from the carcinoma, in uninvolved tissue. After this block removal, the edges of the wound

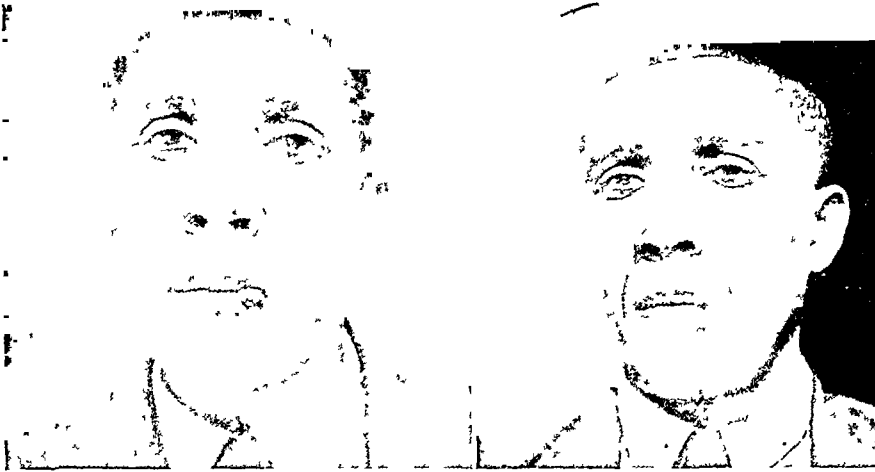


FIG. 1.

FIG. 2.

FIG. 1. Case 1. Epithelioma of lower lip before treatment.  
FIG. 2. Case 1. Well after seven years.

involves the lip or the buccal mucous membrane. A cancer of the lip at or within the mucocutaneous junction presents the same conditions which make it as resistant to the various methods of treatment as one located well within the buccal cavity. Both are bathed with saliva, are irritated constantly by the tongue rubbing over them, and cannot be immobilized to any degree on account of the activity of the facial muscles. If the growth is located on the lip without the mucocutaneous junction and does not infiltrate into the substance of the lip deep enough to involve the small labial glands, it will respond readily to radium exposures. When there is involvement of the mucous membrane or where the growth is bathed with saliva, we have found that the condition is very refractory to treatment by means of surgery, x-rays, and radium, or a combination of these methods.

Formerly, it was customary to remove these cancers by surgical operation, the

were sutured with silkworm gut. Carcinomata of the lip and buccal cavity show a tendency to metastasize early; therefore the fat and glands of the submental and submaxillary regions were removed at the time of operation. The precaution to remove the fat and glands of both sides of the neck, even though the carcinoma was distinctly to one side of the median line, was because of the cross lymphatic drainage of this area. According to DaCosta,<sup>1</sup> the submental, submaxillary, and cervical lymphatic glands are usually involved within three months of the beginning of the cancer. He cites a case of his own where they were found to contain carcinoma cells in less than three months after the origin of the carcinoma of the lip. "This involvement cannot be detected by external manipulation in the earliest stages, hence it is not proper to conclude that glandular involvement is absent simply because it cannot be palpated."

<sup>1</sup> DaCosta, J. C. *Modern Surgery*. Ed., Phila., Saunders, 1917, p. 923.

\* Read before the Fifth District Medical Society of North Carolina, Sanatorium, N. C., April 27, 1923. Submitted for publication July 18, 1929.

With the advent of the x-rays and radium in the treatment of malignancy, it was thought that these cases would

tion that it is not kept moist with saliva and is not rubbed by the tongue, it will usually be cured with exposures to radium.



FIG. 3.

FIG. 3. Case II. Epithelioma of lip.



FIG. 4.

FIG. 4. Case II. Electro-surgical removal.

respond to these measures. It has been our experience that cancers of the lip and the buccal cavity are very resistant to radium

Our method of handling these cases is to remove the cancerous area by electro-coagulation, using the technic of Dr. W. L.

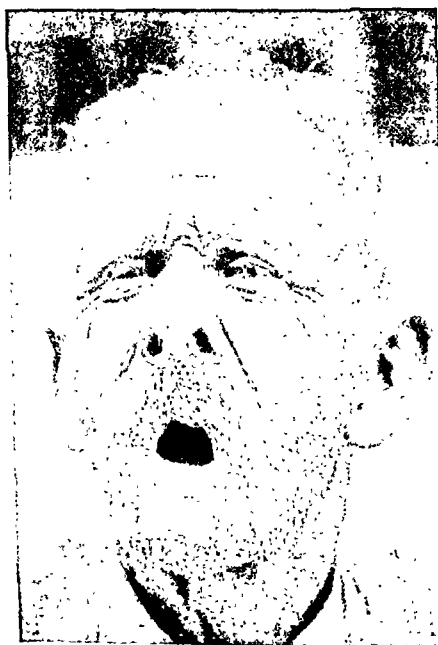


FIG. 5.

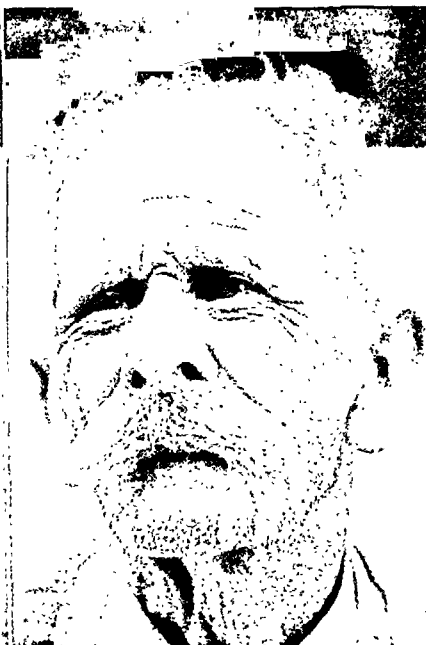


FIG. 6.

FIG. 5. Case II. After plastic operation. Two incisions were made, one on either side,  $1\frac{1}{2}$  in. from median line and parallel with each other, lip was lifted and deformity repaired with result shown in Figure 6.

FIG. 6. Case II. Well.

and x-rays, in fact, that the results are not at all satisfactory. As already mentioned, if the growth is on the lip and removed far enough from the mucocutaneous junc-

Clark, of Philadelphia. The machine is a high-frequency outfit, producing damped currents for dehydration and coagulation. The tissues for about 1 inch about the carci-

noma are blocked with a 1 per cent solution of novocaine. Using the bipolar d'Arsonval current, with the patient re-

tissue to such a depth that the operator is sure that he has gone well beyond the base of the cancer. In the removal of a cancer



FIG. 7.

FIG. 8.

FIG. 7. Case III. Epithelioma of lip.

FIG. 8. Case III. After operation.

clining on the body electrode, which is 18 × 36 in. in size, the operating electrode is inserted into the normal tissues at a

of the lip, the electrode is first inserted from the external aspect for a distance about two-thirds of the way through the

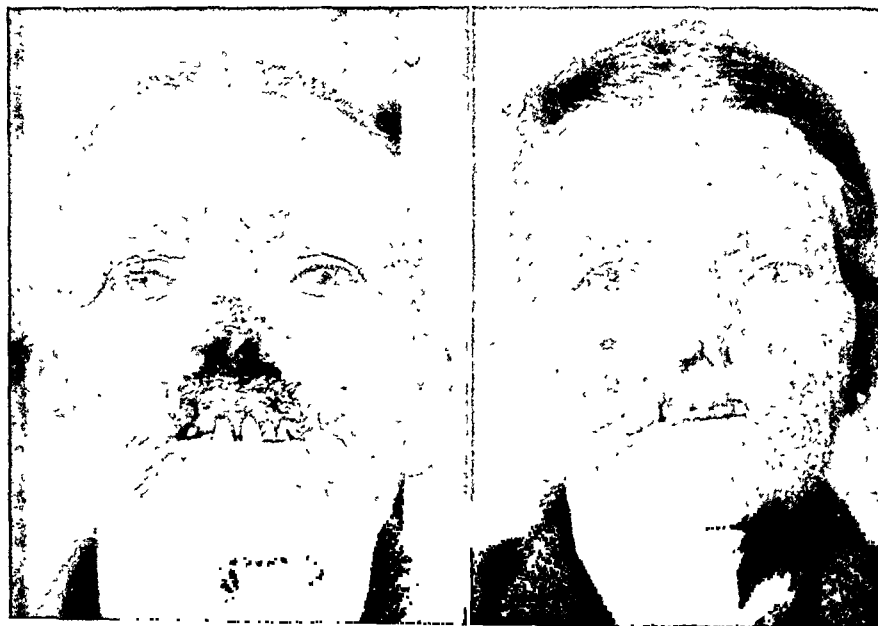


FIG. 9.

FIG. 10.

FIG. 9. Case IV. Epithelioma destroying upper lip and part of nose.

FIG. 10. Case IV. Same after electro-surgical removal.

distance of  $\frac{1}{2}$  inch from the carcinoma at intervals of  $\frac{1}{8}$  inch until the growth is circumscribed. The electrode enters the

lip, in a crescentic line about the cancer and at a distance of  $\frac{1}{2}$  inch from it. Then the lip is everted and a like procedure

on the inside of the lip is carried out. If the cancer is within the mouth, for example on the inside of the cheek, the same proce-

temperature of the electrode to a small degree, but it never becomes hot. Immediately upon removal from contact with the



FIG. 11.

FIG. 12.

FIG. 11. Case v. Patient treated with radium for small cancer of lip about five years ago by author. Three years ago one-half of lower jaw was removed by another surgeon. Four weeks ago electrosurgical removal by author. FIG. 12. Case v. Four weeks after operation. Lesion practically healed. No evidence of lingering growth.

ture is done of inserting the electrode into the normal tissues all around the cancer to the desired depth. Then the electrode is inserted into the cancer itself at short intervals until the whole mass is desiccated out to the line of circular coagulation. The mass of tissue which has been coagulated is then lifted up with tenaculum forceps and removed with a sharp scalpel, the line of incision following the line of coagulation. There is no hemorrhage, as the blood vessels and capillaries have been sealed off by the coagulation process.

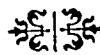
A word should be said here in explanation of what the coagulation method is. It must not be confused with any process of cauterizing or burning. At all times the operating electrode is of the same color and remains at room temperature, even though the milliamperage being used is sufficient to devitalize bone or cartilage. As this process is one of direct diathermy, a certain amount of heat will be generated in the tissues to which the operating electrode is applied. This heat generated within the tissues will in turn raise the

tissue, it may be felt as slightly warm. Emphasis is laid upon this fact, for many has a mistaken idea about electrocoagulation treatment of neoplasms, thinking that it is synonymous with cauterization. After the area is coagulated it does not present a blackened or charred appearance. The operating electrode, though a blunt instrument, is pushed readily through normal tissue and leaves a blanched, pearly, coagulated zone for  $\frac{1}{4}$  inch upon each side. When the mass of coagulated tissue, including the malignancy, is excised with a sharp knife, there is not a particle of oozing or bleeding along the line of incision. The blood vessels, capillaries and lymphatics are sealed off by the coagulation.

We do not think it advisable to dissect out and remove the fatty tissue and glands of both sides of the neck. The lips, face and buccal cavity have a very abundant lymphatic supply. In view of this fact, it is not wise to remove a few glands and not be sure that all are removed, because the resulting chances of rapid metastasis from the stirring up of cancer cells over a

vast network of lymphatics are too great. The close relation of the lymphatic glands of the submental and submaxillary regions with the lymphatic glands of the superficial and deep cervical lymphatic chains is too likely to cause rapid metastasis if surgical measures are instituted as a safeguard against recurrence of the carcinoma in the neck. The anterior neck area from the inferior maxilla to the clavicles is treated preoperatively and postoperatively with

heavy doses of radium and x-rays, in the hope of destroying the embryonal cells of a microscopic metastatic growth before it is large enough to be palpated. All scalpel surgical procedures in cancer of the lip and cancer of the buccal mucous membrane are contraindicated. The matter of excision of the coagulated area is the removal of devitalized tissue for the comfort of the patient, because it would slough away in a few days.



## A CONVENIENT MARKER FOR THYROID INCISIONS\*

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GREENVILLE, S. C.

I HAVE found that bismuth-violet is excellent for marking the line of incision for thyroid operations. The trial necklace in place, the proposed incision is outlined with the dye. When it has dried, painting the field with dilute tincture of iodine or 5 per cent alcoholic solution of picric acid will not obliterate the mark. It remains a black line easily

distinguished. If alcohol alone is used to sterilize the skin, the mark may be obliterated, but not completely so. Though indistinct, enough of the dye may remain to identify the line of incision.

Bismuth-violet is the antiseptic dye recently described by Drs. Barksdale and Wilkinson.<sup>1</sup>

<sup>1</sup> *Southern M. J.* November, 1928.

\* Submitted for publication September 6, 1929.





# MASSIVE DIAPHRAGMATIC HERNIA WITHOUT DIAGNOSTIC SYMPTOMS\*

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UNTIL recent years, diaphragmatic hernia has been more or less of a curiosity and most often found at autopsy. This condition has been more frequently recognized since the advent of the x-ray, and during and since the World War, this type of hernia has been fairly common. It was met with often because of the many abdominal and chest wounds which occurred, leading to a more widespread knowledge of this condition and to a greater opportunity for close study of the traumatic type in particular.

Diaphragmatic hernia has been defined as "the protrusion of any of the abdominal viscera into the thoracic cavity through either a congenital or an acquired opening." Most authorities divide diaphragmatic hernias into the following types, based upon Richards' classification:<sup>1</sup>

- I. True hernias:
  - (a) Congenital
  - (b) Acquired
  - (c) Traumatic
  - (d) Non-traumatic.
- II. False hernias:
  - (a) Congenital
  - (b) Acquired.
- III. Eventration of the diaphragm.

The true hernia has a covering consisting of either pleura or peritoneum or both. The congenital type exists from birth, the acquired cases herniate through a natural opening, while the traumatic and non-traumatic do not occur through a natural opening.

The false hernias are without sac or covering and constitutes 90 per cent of the total. Embryonic development of the diaphragm predisposes to formation of both true and false types of diaphragmatic hernias at certain sites. Definite knowledge

is not yet established as to what factors are at work to prevent proper closure of the esophageal, aortic or vena caval openings. It has been claimed that the aortic and vena caval openings are never the seat of hernia because of their anatomical position and protection. The esophageal cases usually herniate posterior to the esophagus. Occasionally herniation occurs through the space of Torrey or the foramen of Bochdalek; more rarely it has occurred after absorption of a large gumma of the diaphragm. The false acquired hernias are all traumatic and usually result from crushing injuries of the abdomen, back, or thorax, from stab wounds or other trauma. Because of these factors the acquired types are usually found in males and the congenital types are found to be equally divided between the two sexes.

Avulsion of the diaphragm from its costal attachment, either complete or incomplete, may be classed under the acquired false hernias. Eventration, properly speaking, is not a hernia at all, but simply a thinning-out of the dome of the diaphragm with the formation of a pouch to receive the extruding viscera.

The greatest number of cases of hernia reported in the literature occurred on the left side for all types because this side offers an easier exit for the abdominal viscera and herniation is facilitated by the negative pressure in the thorax and the positive pressure existing in the abdomen. Hernia is given by the various authors as occurring from six to twelve times<sup>2</sup> as often on the left side as on the right side. It is reported to be eight times as frequent on this side by Unger and Speiser,<sup>3</sup> who also stated that every abdominal viscus except the genital organs and rectum had

Note: Published with permission of the Surgeon General, U. S. Army, who is not responsible for any opinion expressed or conclusions reached herein.

\* Submitted for publication July 18, 1929.

been discovered at least once in the thoracic cavity. The organs which are most frequently encountered in the order of their occurrence are: stomach, colon (50 per cent) omentum, intestines and spleen.

The right side is protected by the liver below and the right lung above in addition to the thick crus diaphragmatica. Sezary and his co-workers<sup>4</sup> report an unusual right-sided hernia where a short loop of the hepatic flexure herniated into the thorax by passing in front of the liver through the ventral portion of the diaphragm due to the absence of fasciculi normally attached to the sternum and costal cartilages. This case was a true hernia exhibiting a sac.

Hedblom<sup>5</sup> in 1915 made a study of 19 cases of diaphragmatic hernia treated in the Mayo Clinic and 359 found in a comprehensive search of the literature. Two-thirds of the reported cases occurring in civil life were due to penetrating wounds or rupture of the diaphragms by suddenly increased pressure. One-sixth were congenital and one-sixth acquired. In a large percentage, hernia was recognized only after symptoms had been present for many years.

Symptomatology of diaphragmatic hernia varies according to the site of the opening in the diaphragm and the organs or number of organs involved. In the traumatic type there is usually displacement of thoracic viscera by the abdominal organs which have escaped into the thorax. There is commonly dyspnea, cyanosis and disturbed heart action. A tympanitic note may be elicited over the thorax, which may be bulging. Gurgling or sounds of peristalsis may be heard and vomiting and other symptoms of obstruction may be present. Association of hernia of the diaphragm with crushing injuries of chest and abdomen should always be borne in mind. Penetrating wounds of the diaphragm are usually associated with gunshot or stab wounds of abdomen or thorax.

Treatment of diaphragmatic hernia, when any treatment is indicated, is

operative, and, based upon the many reports in literature, the sooner the operation is performed the better the prognosis

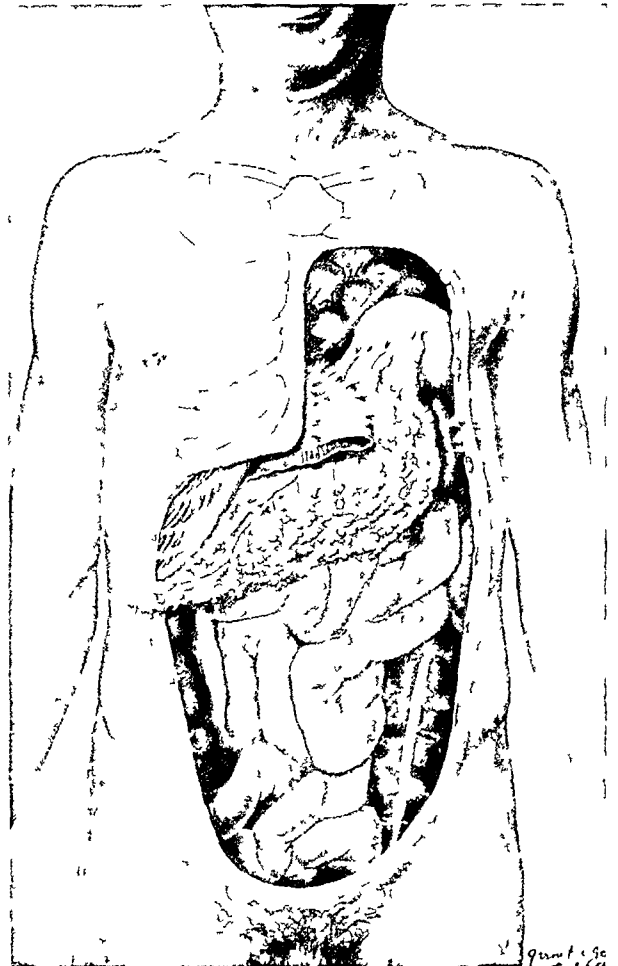


FIG. 1. Case 1. Great omentum, coils of intestines and spleen shown high up in chest and densely adherent. Diaphragm was adherent to transverse colon and to omentum.

and this is particularly true of hernias ensuing after stab wounds or gunshot wounds of the thorax and abdomen. The route of approach may be abdominal, thoracic, or combined. The last is particular useful where the hernial opening is large and contains numerous viscera. The mortality over a period of years has been high, varying from 60 per cent for the thoracic approach to 80 per cent for the abdominal. However, a preoperative diagnosis of diaphragmatic hernia was made in a comparatively small number of cases, the operation usually being performed for intestinal obstruction and hence the high mortality

rate. A preliminary cecostomy to relieve the obstruction as suggested by Truesdale<sup>6</sup> should reduce this mortality somewhat.

wall as has been reported by Bryan<sup>7</sup> in his case of complete evulsion from the left chest wall.

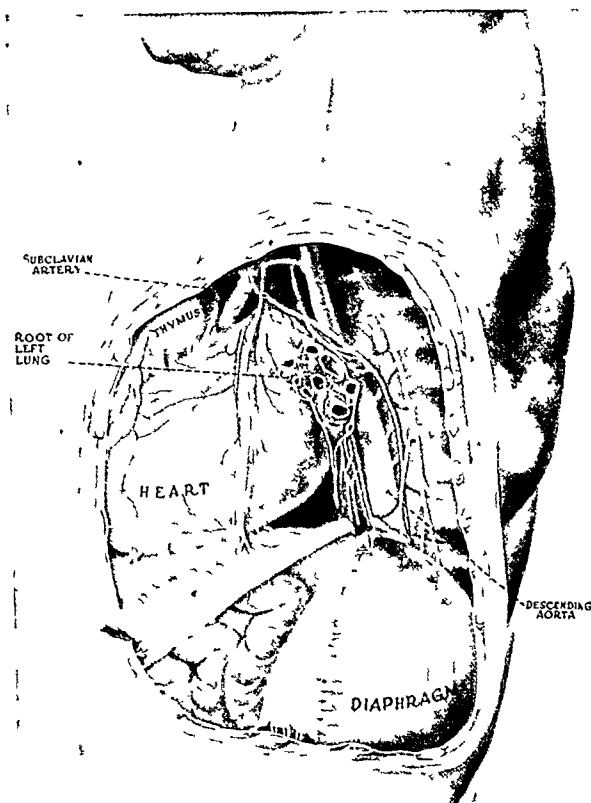


FIG. 2. Case 1. Diaphragm split anteroposteriorly and curled back and adherent to itself.



FIG. 3. Case 1. Showing how edges of diaphragm were brought together with interrupted sutures of heavy chromic catgut.

The site of constriction in these obstruction cases has usually been found in the transverse colon, even if the stomach and small intestines has also passed through the opening. Phrenicotomy, by diminishing the lung capacity, may be useful in cases where great difficulty is experienced in returning the viscera to the abdomen and repairing the rent in the diaphragm.

The following case demonstrates how easily this condition may be overlooked even when x-ray examination is made. It accents the importance of examining these cases in the prone position. Gastrointestinal symptoms were absent throughout and there were few symptoms referable to the chest. It also illustrates the improbability of incarceration occurring in these large openings and shows the extreme difficulty which may be experienced in suturing the diaphragm to the chest

**CASE 1.** C. P. G., a soldier, aged nineteen, was admitted to Walter Reed General Hospital, August 10, 1921, complaining of pain in the back when he stood long or walked far. Present illness began March 21, 1921, when he was at work at Gatun, Panama Canal Zone, digging dirt from a bank which caved in, burying him beneath the falling earth. He was admitted to a local hospital with a diagnosis of fracture, simple, second and third lumbar vertebrae, x-ray examination showing a crushing fracture of the bodies of these vertebrae with marked kyphosis.

In addition he had almost complete paralysis of both lower extremities. By June, 1921 there was marked improvement and he then had good use of his legs except for a slight spasticity and weakness. There were no gastrointestinal symptoms.

Physical examination upon admission was essentially negative except for marked kyphosis in the region of the second, third, and fourth

lumbar vertebrae. The lungs were reported negative. A plaster body cast was applied and after one month a brace was substituted.

connecting the two portions. The meal entered the upper part and practically emptied the lower portion when the patient was recumbent.



FIG. 4. Case 1. X-ray examination following operation showing dome of left diaphragm smooth in outline.

Upon return from a three weeks' furlough in October, he was examined with the view to discharge from the service on account of physical disability. It was then found upon examination of the chest that a tympanic note was obtained on percussion of the left chest from the fourth rib downward anteriorly and in the left axillary region. Over this area borborygmus was marked. Heart sounds were distant but regular, x-ray examination of the chest showed the right lung field clear, and the right diaphragm and costophrenic angle normal. In the left chest from the level of the third rib anteriorly downward the lung field was obscured and no bronchial markings were seen. The diaphragm could not be outlined. In view of possible diaphragmatic hernia, a gastrointestinal series was made. This showed the esophagus normal, the stomach high and apparently in the thoracic cavity extending to the level of the eighth rib anteriorly on the left side. The stomach outline showed a circular constriction at the junction of the lower and middle thirds, the barium passing through a small tunnel



FIG. 5. Case 11. Loop of colon extending above diaphragm to level of second rib.

On standing the lower portion filled. The transverse colon entered the chest cavity and extended to the level of the seventh rib in the axillary line. Fluoroscopic examination showed that the stomach and colon pierced the diaphragm and entered the thorax posteriorly and externally to the apex of the heart.

On January 26, 1922, the patient was operated upon by the thoracic approach. Incision was made in the seventh interspace on the left side and extended from close to the angle of the ribs posteriorly to the anterior axillary line anteriorly. The seventh and eighth ribs were divided at either extremity of the incision and the intercostal muscles cut through and ribs turned up and down. The great omentum and coils of intestines presented which when pushed aside showed what appeared to be a complete absence of the diaphragm and the hand was easily introduced into the abdominal cavity. The spleen was seen high up in the chest to the outer side, densely adherent to the chest wall and to the torn margin of the diaphragm, which was also adherent to the transverse colon and to the omentum. (Fig. 1.) The viscera were dissected

free and easily returned to the abdomen. The diaphragm was split across its fibers anteroposteriorly and was torn away from

rent in the diaphragm. In this case the symptoms present were predominantly referable to the chest.

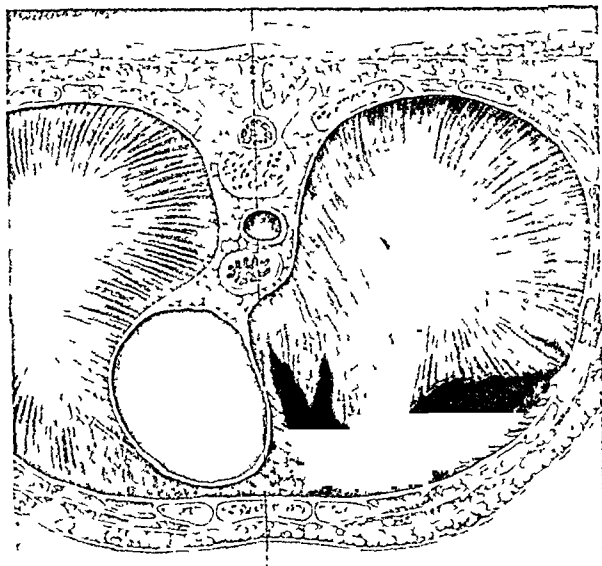


FIG. 6. Case 11. Large ragged rent in diaphragm which was torn in at least three directions.

its attachment to the chest wall about 1 inch posteriorly and about twice that distance from the anterior wall. The inner side of its anterior attachment was torn away for a distance of  $1\frac{1}{2}$  inches on each side of the rent. This formed a quadrilateral-shaped flap which was curled back and adherent to itself. (Fig. 2.) The bands of adherent connective tissue were divided and the edges brought together with interrupted sutures of heavy chromic catgut. (Fig. 3.) The greatest difficulty was experienced in suturing the diaphragm to the chest wall.

The patient made an uneventful recovery and x-ray examinations one month after the operation showed stomach and colon in normal position within the abdomen and no defects or abnormalities demonstrable. The dome of the left diaphragm was smooth in outline but limited in its excursion. (Fig. 4.)

The next case again illustrates how diaphragmatic hernia can be overlooked in spite of x-ray examination and how necessary it is to examine these cases after ingestion of an opaque meal in both the upright and prone positions. This case was of long standing and shows how difficult it may be to return the viscera to the abdomen successfully and to repair the

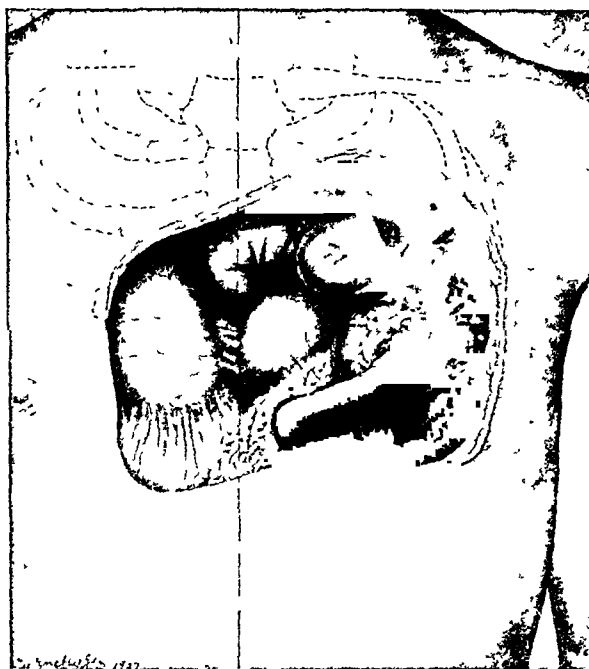


FIG. 7. Case 11. Stomach, loop of colon, spleen and portion of small intestine protruding into thorax through rent in diaphragm.

CASE 11. A. S., a soldier, aged forty, was admitted to Walter Reed General Hospital, December 2, 1925, complaining of pain in the left shoulder, shortness of breath, especially at night, and cough. He stated that in November, 1918 he was kicked in the left chest by a mule and almost immediately developed a cough which had persisted up to the time of admission. Following the kick he was sick in quarters for one week when he returned to duty which he continued to perform until 1923, when he was admitted to hospital with a diagnosis of left pleurisy with effusion. X-ray examination at this time showed a marked increase in density extending from the fourth interspace to the base on the left side, obliterating all lung markings. There was a dense band, apparently pleural adhesions, extending across the chest at the level of the fourth rib. The heart was displaced to the right.

After five months' observation the patient was transferred to another hospital for the treatment of pulmonary tuberculosis from which he was later again returned to duty. He did special duty as a saddler until the expiration of his enlistment. He re-enlisted

but was unable to do much duty and was sent to Walter Reed General Hospital for treatment. Physical examination at the same time of

seventh interspace extending from anterior to posterior aspect of the chest. The seventh and eight ribs were sectioned to permit easier

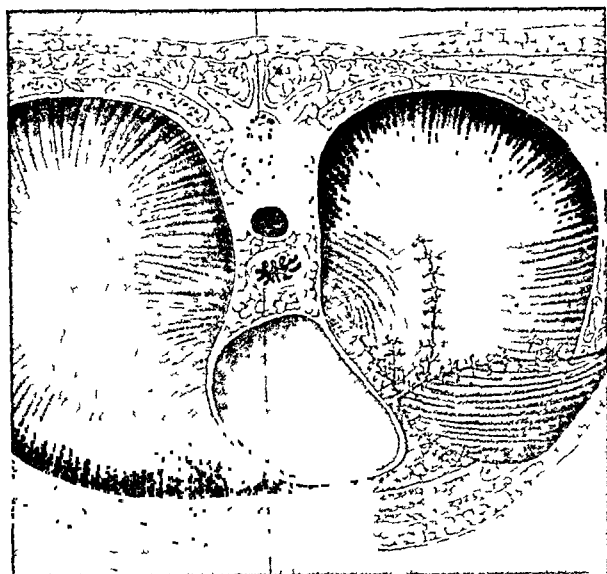


FIG. 8. Case 11. On approximating rent in diaphragm, defect remaining was closed by bringing inward from thoracic wall a muscle flap from latissimus dorsi.

admission was essentially negative except for the chest. The heart was not enlarged, sounds were normal, but it was displaced to the right. Examination of the chest showed tactile fremitus diminished over the lateral aspect of the left chest. The percussion note was increased and the breath sounds and spoken voice sounds were greatly diminished over the outer aspect of the left lung. X-ray examination of chest showed marked displacement of the heart to the right. The right lung was negative. The right diaphragm was smooth and the left dome elevated. There were two large gas bubbles in close relation to what appeared to be the inferior surface of the diaphragm. Examination with the opaque meal showed the above shadows to be in the stomach and colon. In the upright position they ascended so that a part of both viscera was above the diaphragm. The funds of the stomach reached to the level of the second rib anteriorly. A long loop of colon appeared above the level of the diaphragm and reached to the level of the second rib. (Fig. 5.) In the prone position the outline of the diaphragm was not definitely shown. The stomach emptied in six hours.

On December 31, 1925 the patient was operated upon through an incision in the



FIG. 9. Case 11. X-ray following operation showing muscle flap in place completely obliterating defect in diaphragm.

access to the cavity. A large rent about 5 inches in diameter was found in the diaphragm. (Fig. 6.) Through this rent protruded the stomach, a loop of colon, spleen and a portion of the small intestines. (Fig. 7.) The stomach and the colon were adherent to the mediastinum. After freeing the stomach and colon these viscera were replaced with difficulty in the abdominal cavity. Attempt was made to repair the rent in the diaphragm. This rent was ragged in outline, the diaphragm being torn in at least three directions and after drawing the edges together there still remained an opening nearly as large as the palm of the hand, which could not be approximated. A portion of the latissimus dorsi was brought inward from the thoracic wall and the defect closed by this muscle flap. (Fig. 8.) Before closing the chest the lungs were inflated by positive pressure. At the completion of the operation it was noted that the intra-abdominal pressure had been markedly increased due to the replacement of the abdominal viscera which had been so long outside their natural cavity. The patient left the operating room in good condition. The day following operation x-ray of the chest

showed the muscle flap in place completely obliterating the defect in the diaphragm. The costophrenic angle was clear. (Fig. 9.) In the afternoon the patient's abdomen became distended and tense. All efforts to move the bowels failed and under local anesthesia an enterostomy was done and a Bonney tube inserted in a loop of ileum. The day after the enterostomy the patient began to manifest symptoms of tetany. The convulsions persisted in spite of every treatment, gradually becoming stronger and of longer duration until the next evening when death ensued. Autopsy showed all sutures intact. There were about 500 c.c. of a bloody exudate in the left pleural cavity and a fibrinous pleurisy of both lungs with some plastic exudate on the left. The upper half of the small intestines were distended and the lower half were empty. A preoperative phrenicotomy would have aided materially in the closure had the magnitude of the condition been suspected.

In conclusion it is desired to stress again a point which has been emphasized many times before and that is that massive diaphragmatic hernia in a large majority of cases is recognized only after it has existed for a long time. Objective and subjective symptoms may be few and there may be little in the history of a given case to suggest the presence of such a condition.

Diaphragmatic hernia will continue to be overlooked unless careful x-ray examination is made including examination by means of the opaque meal with the patient in the upright and prone positions.

These cases show the improbability of incarceration with its attending intestinal obstruction and the difficulty sometimes encountered in repairing the rent in the diaphragm.

The part played by crushing injuries and external violence in causing this type of hernia should always be borne in mind.

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# TRAUMATIC SPONDYLITIS\*

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FOLLOWING trauma many patients develop symptoms of a back disability equivalent to a spondylitis. In spite of repeated examinations, from the symptoms the patient presents we are unable to make a diagnosis other than spondylitis and by this we mean that there is a sensitiveness of the joints of the back, usually the lumbar spine. His complaints and the way of handling himself correspond to a general spondylitis of a mild inflammatory character and the essential complaints are pains in the back, a weakness or inability to use his back and a spasticity of the spine which acts like a reflex spasm. The pains may not be referred to definite locations; they are usually fairly general and are not diagnostic in themselves. The spasticity is not a fixed condition; it is possible to secure relaxation and motion in recumbency and the weakness as in cases of sprain is not real but simply an inability to use the muscles without causing increased reflex spasm and pain. The roentgen-ray findings are essentially negative showing the degree of bone ossification corresponding to the age, congenital anomalies and unevennesses which we know the patient has had without symptoms.

When the symptoms allow of a more definite diagnosis on an anatomical basis we can improve on our nomenclature. The essential elements of this group, however, do also apply to cases with an interesting anatomical lesion whose diagnosis after all depends upon our fortunate ability to gain concrete evidence of a condition which in itself cannot explain the patient's general condition, such as fracture of a rib or tip of a lateral process. When we speak of this condition as a spondylitis we bring to each other's mind a definite clinical syndrome and the terminology is therefore justified. A true spondyli-

tis it is not. Only very rarely is traumatism alone the cause of an inflammatory reaction in the spine such as we can demonstrate readily following other joint fractures. Slight impactions of vertebral bodies may occur but if the x-rays are not definite we have no right to make a diagnosis of a serious lesion. I say serious mainly because so many of the cases are known to run a prolonged chronic course. All sorts of lesions do occur but when we resort to the term traumatic spondylitis we denote the absence of objective signs leading to a more definite diagnosis. This symptom complex can best be analysed in three factors:

1. The traumatic condition which is equivalent to a back sprain.

2. The inflammatory, which may be said to be present in all of us and which is a reaction of the tissues and largely dependent on our local sensitiveness and preexisting arthritis.

3. Lastly and more important: the psychic; for it is through this that the symptoms of the organic conditions are expressed and amplified. These factors are very hard to separate, are inherent in the patient and give ground for considerable difference of opinion. It is by a clinical study of these cases that we must value relative importance of these elements.

## THE TRAUMA

Back sprains are usually induced by indirect violence. Lifting and falling are the most common causes. Torn ligaments and fascia, internal bruising, ecchymosis and edema are the local lesions. When a bone lesion exists we dignify it with a more concrete diagnosis. It is impossible to demonstrate joint separations, such as a theoretical sacroiliac relaxation or tears of other ligaments of the spine. A sprained

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back certainly does occur the same as any other joint sprain and may result in a permanent weakness, but it does not adequately account for most of the clinical picture. We must also consider the possibility that we are dealing with a case that turns out to be a "Kummell," post-traumatic vertebral body absorption. In these cases after a fairly brief disability due to the trauma itself a second stage of comparative recovery sets in during which the patient may even go back to work. This is followed after weeks or months by a collapse of vertebral body with a kyphosis and all the secondary symptoms of a spinal fracture, that is, the localized pains and disability. There is an inflammatory reaction. It is this clinical possibility that prevents us ruling out an organic lesion and encouraging our patients with the certainty of its non-existence. If this condition exists in lesser degrees than a frank collapse we have no means of diagnosing it. We cannot make out the post-traumatic inflammatory reaction without x-ray changes as an objective sign.

I have purposely omitted a discussion of the effects of concussion on the central nervous system. Whether the underlying condition is more or less organic does not change the objective.

#### INFLAMMATORY REACTIONS

Joint and fascial sensitiveness occurs as a fixed condition in many people. Throughout life they have attacks of real pain in and about joints and although apparently not neurotic or hysterical are readily cured of these pains. Their tissues are more sensitive and more easily inflamed. The tissues may be synovial, peri-articular, fascia, bursa, in fact any tissue well supplied with nerves of pain.

Today we are finding more of our arthritics harboring infections and possibly we will come to the conclusion that low-grade infection may be present in our body tissues as in our intestinal canal with non-pathogenic organisms causing no gross changes. After a trauma and a

destruction of the tissue the local reaction changes, the bacteria gain a foothold and an inflammation ensues. If this reaction is present in a very large percentage of all people, I feel we will have to call it physiological. The liability to reaction after trauma is not entirely pathologic.

With age, sclerotic changes may be demonstrated in joints, as in arteries. These productive or sclerotic changes progress silently; there is less elasticity and the tissues are less able to repair after injury. Mild spondylitis deformans is common in people without symptoms. Injury to such a joint would be more liable to cause an inflammatory reaction.

#### PSYCHIC REACTIONS

The normal psychic reaction of a person to a trauma is that which will occur in 80 per cent of all people. It is in the recovery that the differences between cases will show themselves most. The stronger recover more completely and the psychically weaker continue with their ailment. The stronger face realities and answer the situation. The weaker delay in adapting themselves. The hysterical live under conditions they imagine and that are not existent as with an infantile mind, in this respect having an incomplete mental development, and they do not place true values on facts. We have been in the habit of considering reaction as pathologic or abnormal. The exciting circumstance is abnormal the reaction is normal. Also any reaction which 80 per cent of all people have cannot be considered pathological and cannot be given as an example of an abnormal condition. We must term this functional, that is within the limits of ordinary normal physiological action. The human being is ever ready to believe things that appeal to him and are easy of conception mentally. On test we find our adult brain still functioning in childhood manner, that our rationalizations are not sufficiently separated from our emotions or desire and that we are too prone to live our desires. At each uncomfortable situation we seek

to balance our conceptions to evade the uncomfortable situation at hand while an adult mind would be more ready to allow it to stand as is and be more immune to its unpleasantness. It is typical in these cases that the psychic disturbance caused is to be met with one at that moment less unpleasant. The patient's attention is therefore transferred to explainable pains, aches and suffering and the memory of these linger with more intensity than does the pain. Also the inhibition of activity, giving a greater feeling of insecurity, depresses the patient's power of action and leaves him in a distressed mental state. This acts as a vicious circle as it diminishes his power of recovery.

It is perfectly easy to see why a person who is constitutionally neurasthenic or hysterical will get into difficulty and stay there, but it is wrong to say that the same reaction does not occur in what we must call normal people. After all, clinically it is the heretofore normal people that give us these difficulties while the constitutional inferiors show their natural bend previously and do not seem to present special problems after trauma to the extent we would expect.

In attempting to explain phenomena doctors are very liable to accept any equation which tallies and is logically sound. Unfortunately we have only one method of proof and that is empirical or clinical. Evidently our conception of what should exist in a human being has been leading us into a false explanation. If we are in difficulty in these matters we find ourselves worse off when we attempt an explanation to a layman, be he the patient, a relative or legal aid. A solution or diagnosis is asked in terms which do not exist.

Immediately after trauma it is impossible to go into the patient's psychical condition because the traumatic condition dominates his attention. As the recovery is gradual his ability to exaggerate and amplify increases and we are in a quandary to estimate the remaining physical disability which originally was considerable

and his hysterical element which was previously not discernible. The memory and the fear of what had gone by still holds his attention. An attempt to get along in the face of the previously induced sensitiveness and apprehension focuses his attention on a way out instead of on a way forward.

Without a frequent examination he feels himself neglected and with it his attention is centered. Examination by different men necessarily has a bad effect. If the second man fails to find what the first man did he loses sympathy and confidence but if he finds more the patient has foundation for doubt of the value of his previous treatment, which is still worse. Any small matter such as the exact location of a sensitive spot is enough. Whatever symptoms the patient has must be valued in terms of the three underlying conditions: a sprained back, a sensitive tissue and an intrinsic ability in a human being to modify his conception of his surroundings and being by what we call voluntary attention. Whether this last is organic or not is beside the question. Personally, I believe all thought is organic like a higher compounded reflex and our ability to translate it into a medium termed words induces us to consider it a different entity, which it is not. It seems, however, that we have the ability, within limits, to direct our attention as we see fit. Maybe even here it is not voluntary but simply an expression of an emotion. In this case our rationalization would be fatalistic or predetermined and simply a higher reflex. Such a conception would let us claim this entire symptom complex as of organic origin.

From a practical point of view we know that the major factors in a traumatic spondylitis cannot be dependent solely on the strain of lifting an object the like of which has been done for years. We must conceive our symptom complex as tri-dimensional, in which one dimension dominates but cannot exist alone. As we see these cases, many border on what we would

like to term a neurosis, this would imply that the organic back lesion did not exist. The diagnosis neurosis should not be made on negative findings, it is a real condition. Unfortunately only rarely can we commit ourselves to that effect; usually our opinion must be suspended until we can see what the case is doing and to what extent it can be modified or compensated by effort.

#### TREATMENT

The treatment of the immediate accident gives us little difficulty. We can always put on a plaster cast or a brace and then let him up. Some prefer keeping the patient flat in bed and then giving no brace, believing that there is a limit to the bed confinement but none to the partial disability; others feel that the sooner the gradual recovery is inaugurated the better for the patient. Physically either method is satisfactory; psychically either may be wrong. Personally I prefer getting him on his feet in a plaster cast because it relieves this doubts and fears, is safest and is a better way of controlling the patient.

After a plaster is no longer necessary the question of physical therapeutics is considered. The easy cases will get well regardless, the difficult cases thrive on attention and even get to enjoy their illness. If we do not do something for them they feel neglected and if we do something for them they do nothing for themselves. I see all too many cases in which physical therapeutics work in the wrong direction. It gives them a crutch to lean on so they do not stand on their feet. Whatever benefit may be derived from the temporary diminution of physical discomfort is negated by the procrastination of effort on the patient's part. Handing patients over to a technician or a masseur makes matters worse. If it is necessary to resort to electric treatments on account of the patient's desire for attention we should use a modality that is not too comfortable and restful but one that is stimulating and painful. I suggest a metal electrode with

a Oudin current. This raises beautiful welts on the patient's back and temporarily relieves him of his own pains. It is like the Pacquelin cautery by which we cured more ailments than we ever diagnosed.

The reasons for the prolonging of these attentions are not valid medically. Giving the mental encouragement needed by the patient to exert himself is a greater strain on the doctor, for which he gets no thanks. A premium is placed on the cultivation of a condition which we are later asked to remove as if it had no basis and did not exist, but which is then deep in the patient's being. After there is cultivated a neurotic condition we refer the patient to a neurologist who then attempts to make a purely neurological case and unwind the thread. This mental treatment can only be done by the physician having the patient in charge from the beginning, and in these cases it must be done by physical means. These cases go to the orthopedist and it is he who is responsible for the eventual outcome. We have no right to make neurotics of them and then ask for their cure, although that is the method now used, particularly on account of the legal and commercial aspects of these cases. We may not be able to relieve these cases of all their aches and pains but we should diminish instead of exaggerate their disabilities. From whom if not from us should these patients get help. If we insist on considering ourselves only bone carpenters we do wrong in holding these cases.

We cannot make the weak strong nor the sensitive insensible but we can do something to diminish their difficulties. I do not know how to make an accurate chronometer out of an Ingersoll watch nor would any one ask it of me, but I do know that I can use an Ingersoll for the same purpose and to a better degree of satisfaction than a perfect timepiece. The same philosophy must be hammered into the patient. They have no right to expect a perfect condition or a return to a previous one, people do not get younger

again. What they must seek is a method of getting along as well as before with what they now have. Therefore treatments in any form must be secondary to function. Nothing succeeds like success, use of the back is of more value in curing the back than any artificial applications or motions.

Gradual return to work by graded work and a gradual increased effort on the patient's part is the only possible and sane solution. Occupational therapy should be work in mild doses and not entertainment with useless occupation. For these cases outdoor occupation, such as work in a garden, is better than sewing. A prize fighter first tries someone his own size whom he can handle before taking on a champion, for a knock-out would shake his confidence in his ability and from this attitude he could not put forward his best efforts. We cannot expect a weak and sensitive patient to do a man's work on his first attempt at return. Too often we see them, after a two or three day try at their old job, quitting completely disheartened. Their next attempt at work will be complicated by fear of failure and their courage to succeed will be crippled. Part time work on part pay is indicated. Social conditions are against us in our attempt at rehabilitation. That is not our fault; they must be changed, we cannot change nature.

When in these cases the dominant lesion appears to be psychic and the remaining physical lesion questionable, the neurologists have accepted these cases as being neuroses. They label them functional, by which they imply the patient is responsible for his mental activities and that it is his will that is accountable for his condition. They throw out a camouflage screen of motive. Nobody exists in this world without motive, everything is explainable that way. Who wants to be weak? Labelling these conditions functional in no way answers the question. We are all candidates for the same physiological process. They were unwilling to consider the milder degree of hysteria and

neurasthenia as pathological. The neurasthenic is essentially weak and tired and lacks ability to exert effort. The hysterical is living an incorrect mental assumption. He should be curable by a correction of his mental attitude or suggestive therapy. The neurologists show examples where simple suggestion effects cures. These are the long-standing cases where the organic lesion, if present, has entirely run its course. A sudden sharp suggestion is dramatic and appealing, its failure immunizes the patient to more attempts. The scientific doubt that exists in the mind of a learned man prevents his assuming the self-confident attitude of a charlatan and making the definite promises the patient desires. In this regard the quack has a great advantage and is bound to have some success. The socialization of medicine will add to the difficulty of handling these cases and improve the field for charlatans. Patients of this mentality and distrust do not lend themselves to a physician who insists that he should govern the patient's actions. The patient, like a child, wants to guide the doctor's hand and does not confide himself to his care. This subject has been treated by the neurologist as if it was purely a mental condition.

Our inability to completely comprehend these cases is no hindrance to our curing them on an empirical basis and I do not think it is a matter of supreme importance as to which element, the organic or the mental, should be emphasized. From a practical point of view these patients need help, we are the only ones who can give it to them and our reward will come, but unfortunately by being fed more unsatisfactory work if we show we can digest it. Then we will be doing something to elevate the status of the medical profession beyond that of a technician.

#### DISCUSSION

DR. ROBERT E. HUMPHRIES: Dr. Oppenheimer's paper is an important contribution to the study of backache. It is my opinion

that these unsatisfactory cases have some real basis for the continuance of their pains. The patient usually gives a history of having felt something snap in his back either while lifting or when falling. X-ray pictures may be negative as to disease or traumatism, but it is well to remember that disease in its early stages, regardless of its nature, may not show in an x-ray.

We see many cases who have very definite signs of trouble with negative x-ray pictures. If the doctor tells such a patient that he has nothing wrong with him, the patient is likely to assume that the doctor does not know what he is talking about and will consult someone else. After this has continued through many consultations, one doctor telling him he has rheumatism, another that he has arthritis and still another that he has lumbago, etc., he becomes convinced that he has some rare disease of which the doctors know nothing. This condition of affairs is largely due to ourselves, in our efforts to convince the patient that we know more than his last consultant.

There are many factors in an injury that must be considered and I believe the most important is shock. We do not hesitate to do a double osteotomy on a patient, if necessary and yet if that same patient had both legs broken in an injury he had received he would be liable to die of shock, the effect of which is largely intestinal. A man came to the hospital complaining of an injury he had received in one of the nearby factories; in falling he had broken a rib, which had been treated by the doctor at the Industrial Commission. He still complained of pain but was considered a

malingerer. On examination we found a distinct kyphosis at the 8th dorsal vertebra, markedly increased knee jerks and ankle clonus; he was scarcely able to walk. An x-ray showed a wedging of the 8th vertebra. He was admitted to the hospital, operated on, but did not regain control of his limbs. After his discharge from the hospital he was taken to court month after month for a hearing, his paralysis gradually growing worse all the time, when his case was finally settled he was unable to walk. Within two months of the settlement he regained complete control of his legs. I am quite sure that his condition would not have cleared up if a favorable settlement had not been made in his case, because this man was fearful of ever regaining his health again and therefrom becoming a public charge. When this fear was removed he promptly regained his health.

DR. E. D. OPPENHEIMER: The subject is much too large to be covered briefly. There are too many angles to it; these cases come to us months after injury: the objective examination is negative: there is nothing organic on which we can put our fingers. If other opinions are asked, probably eight different men will give eight different opinions. Which is right? In these cases we have various elements that are developed to different degrees and we cannot explain one without considering the others. With time, the traumatic element diminishes and the mental increases. These patients should not see various physicians. It is bad for them: it adds to their doubts, they should be under better control than they are.



# THE GAUZE PACK IN THE TREATMENT OF EMPYEMA OF THE PLEURAL CAVITY\*

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IN THE surgical treatment of empyema of the pleural cavity, the so-called open method has regained favor during the past few years. The procedure designated as the closed method is ideal when it accomplishes perfect results, but it too often must be followed by open drainage. One of the principle reasons for the origin of the closed method was the thought that air in an infected pleural cavity was detrimental, mainly through preventing an expansion of the lung. The presence of air in an infected pleural cavity has never been proved to be harmful and the average application of the closed method of drainage rarely prevents the ingress of air. The presence of air is not, apparently, the cause of failure of the closed method; the lack of sufficient drainage must be given primary consideration.

The open method, with or without a rib resection, and the insertion of drainage tubes is usually satisfactory. If the visceral wall of the pleural cavity is not too thick and inelastic, the cavity is generally obliterated in from ten to thirty days. During this time there is profuse drainage of pus, and the opening into the cavity soon becomes just large enough to admit the drains, preventing an inspection of the visceral pleural wall.

The advantages of the draining tube procedure are that it is simple, easily cared for, and causes little distress. The disadvantages are that the drainage is most profuse and prolonged, and the lung "flaps" during respiration, for several days after the operation, producing a distressing increased cardiopulmonary rate. Not infrequently the exudate pockets away from the drainage tube, and the time for removing the tube is always in doubt, resulting often in a prolonged sinus.

A few years ago I began using the gauze pack in the surgical treatment of empyema of the pleural cavity with results so satisfactory that I feel that they should be reported. I have used it only in those cases requiring open drainage and where the lung was not permanently compressed by an organized thickened pleura and intra-pulmonary scar tissue. The advantages of the gauze pack are: (1) it holds the lung steady following the operation, which is most comforting to the patient; (2) it clears the exudate rapidly from the walls of the cavity; (3) it breaks up the numerous small abscesses in the periphery of the lung, which are usually present; (4) it eradicates external purulent drainage almost completely after forty-eight hours; and (5) it brings about an obliteration of the cavity at least as rapidly as any other method. The disadvantages of this method are that the gauze pack must be changed daily by someone experienced, and the first change is more or less distressful without light anesthesia. The wound in the thoracic wall may require dressings for several weeks after the drainage from the pleural cavity has ceased.

About 4 inches of a rib is always resected and the ends covered with surgical wax. As much of the exudate as possible is removed with a Poole sucker through a stab wound into the pleural cavity. The wound is then made about 4 inches long and, in order to facilitate packing, the parietal pleura is attached to the skin by interrupted sutures. The cavity is now open for inspection, and all of the exudate is removed, adhesions are divided and the walls are very gently wiped with gauze. Secondary pockets are widely communicated with the main cavity. With a long

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curved dressing forceps the entire cavity, starting at its extremity, is uniformly packed with bismuth iodized gauze, which

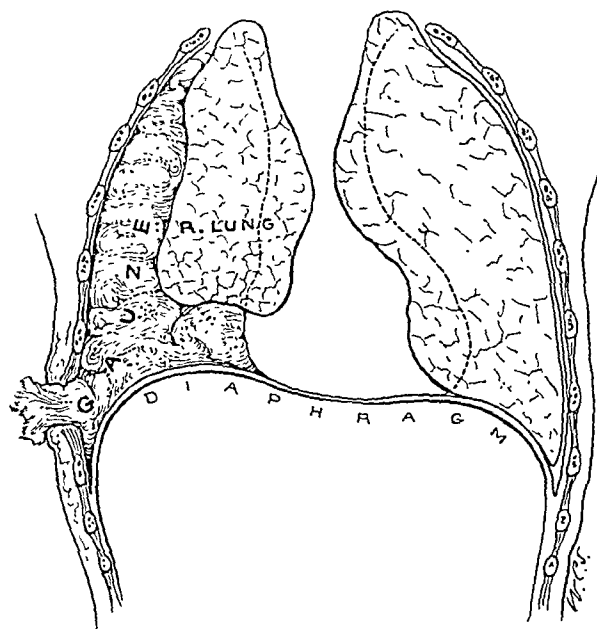


FIG. 1. Pleural cavity firmly packed with gauze. Note that every portion of infected pleura is in contact with the pack.

type of gauze has proved most satisfactory. This packing must be most painstakingly performed with the gauze fluffed. The first packing braces the lung by holding it in a fixed position, giving the patient a sense of comfort by preventing an increased cardiorespiratory rate. The succeeding packs are less firm and the cavity each day admits less gauze. Wrapping the blade of a broad retractor around the upper edge of the opening allows gauze to enter the cavity with no friction. In six or seven days, further use of the pack is rarely needed. The older the condition, however, the longer it takes to obliterate the cavity, and 10 days of packing may be necessary. Purulent drainage is generally absent after the third day, which is a marked contrast to those cases in which rubber tube drainage is used. In addition, the patients appear more comfortable owing mainly, I think, to the gauze acting as a splint and bracing the lung and mediastinum. The operations can generally be preformed under local anesthesia and the patients are, in most instances, out of

bed and walking on the second or third day. Besides acting as a drain the gauze pack serves a valuable purpose in acting as a splint or brace to the lung as well as a counterirritant to the infected visceral pleura which assists greatly in the eradication of its purulent exudate.

#### CASE HISTORIES

CASE I. University Hospital No. 28524. Boy, aged five, lobar pneumonia one month before admission. On May 25, 1929 right 9th rib resected and 500 c.c. thick cream-colored pneumococcic pus evacuated. Cavity packed with fluffed gauze which was continued daily. After second packing practically all purulent drainage had disappeared. The temperature was normal on the third day. Six days later cavity was practically closed excepting a small area in the region of the resected rib. Patient was out of bed the second day following the operation and appeared in excellent condition.

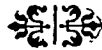
CASE II. University Hospital No. 25318. Boy, aged fourteen, had "flu" three weeks previously. On April 28, 1928 right 10th rib resected and 650 c.c. of a thin dirty-brown-colored pneumococcic pus evacuated. Cavity packed with fluffed gauze and patient insisted upon walking back to his bed owing to the solid feeling in his chest. This patient was out of bed on the third day and with a normal temperature. Practically no purulent exudate was visible after the second day. At the end of the ninth day the cavity had disappeared and no more packing was necessary.

CASE III. Wise Memorial Hospital No. 27744. Male, aged fifty, had "flu" one month previously. On January 23, 1929 right 8th rib resected and 1500 c.c. of thick cream-colored pus evacuated. Cavity packed with fluffed gauze which was continued daily. After the third day practically all purulent exudate had disappeared and the temperature dropped to normal on the fifth day. It required ten days of daily packing before the cavity appeared to require no more drainage. The patient was out of bed on the third day and felt quite well. This case is reported because it required the greatest number of gauze packs in my total series of 8 cases.

CASE IV. Wise Memorial Hospital No.

20621. Male, aged fourteen, had "severe cold" three weeks previously. On February 16, 1925 right 8th rib resected and 400 c.c. of a thick dirty-brown-colored pus was evacuated. Cavity packed with fluffed iodoform gauze, and after the second daily packing no external drainage was visible. The temperature dropped to normal on the second day and remained so after the fourth day. In five days no more packing could be admitted and the patient was out of bed and feeling quite well.

CASE V. Wise Memorial Hospital No. 21729. Male, aged nineteen, had pneumonia ending three weeks previously. On October 12, 1925 4 inches of seventh right rib resected and 400 c.c. of a thick yellow pneumococcic pus evacuated. The cavity was packed with iodoform gauze and on the third day no signs of external purulent drainings were visible. The temperature dropped to normal on the sixth day and no further packing was necessary after the eighth day.





# APPENDICEAL ABSCESS (WALLED OFF)\*

HARRY M. VOORHEES, M.D.

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THE subject I am discussing this evening does not consider those cases of appendicitis in which, from a surgeon's standpoint, the earlier appendectomy is performed, the lower our mortality; also we are not concerned, in this brief paper, with the diagnosis, which probably requires more acumen and judgment than the treatment of this condition, to which we are limiting our discussion.

It is my opinion that we see more of these undiagnosed or mistreated conditions than ten years ago, which is very easily explained by the existence of our numerous, so-called medical cults, faith healing, and the sure-cure electrical devices, or what not, now in vogue and given such wide publicity that the unsuspecting public are easily sold.

There are two recognized types of treatment, namely:

1. Surgery with its numerous technics, differing as to the individuality, experience and judgment of the operator.

2. The "starvation treatment," generally known as Ochner's method.

With the latter, I am aware that good results are obtained only in the hands of men who have had years of experience and whose surgical judgment far excels the average. Even in these expert hands, the errors in diagnosis alone usually exceed 2 per cent. As a wrong diagnosis usually results fatally, we have this percentage to add, in determining the true death rate by this method.

In the surgical handling of walled-off appendiceal abscess there are six essential points of technic which I bring to your attention, and if followed by the profession at large, will result, I believe, in lowered mortality and morbidity of our patients, namely:

1. Incision
  - (a) Location and type
2. Exposure of abdominal viscera
3. Treatment of appendix
4. Drainage
  - (a) At operation
  - (b) Postoperative
5. A sutureless wound
6. Secondary appendectomy.

It seems a waste of time to tell surgeons to make their incision over the area, which is either flat on percussion or bulging and visible to the eye, or in which, if this condition does not exist, the abscess and often indurated abdominal wall can be easily palpated. It is a fact, however, that patients are operated on today, with easily localized pathology, in which no attention is given to the location of the incision. As the appendix is normally under McBurney's point, the attack is made in this region, and we see the non-infected portion of the abdomen opened, and the operator proceeds to perform an appendectomy, after breaking through an abscess wall. If this patient survives, the surgeon did not cure him.

1. By the type of incision, I mean a clean-cut, non-dissecting incision. Just the other day, I saw a man's lower abdomen opened in the midline for intra-abdominal pathology. While the approach was being made, the skin and underlying fat was dissected back on both sides, exposing a strip of fascia 4 inches wide, and I thought at first a herniorrhaphy or some form of plastic surgery was in the making. There can be no excuse for exposing more than the minimum amount of abdominal tissue to infectious material from an underlying abscess. Our incision should be clean-cut and direct down to the pathology.

An ideal incision should, theoretically,

\*Read before the Los Angeles Surgical Society, February 8, 1929.

be as wide as the abscess; and in thick abdominal walls is of necessity much wider. Rarely are our incisions too long. Have you ever seen your patient on the day following operation, after shrinkage has taken place, and been surprised at the small opening you made?

2. All of us feel a sense of security after operating a badly infected appendix, if in the removal we have seen and handled only the cecum. By making our approach in the proper location, the abdominal contents outside the abscess cavity are never seen. I realize that there exists the occasional case where the pathology is located intra-abdominally, and no contact with the parietal peritoneum, anteriorly or laterally, is made. In these centrally located conditions, often we can defer surgery until an approach can be found, with no intervening intestine, provided no ileus exists to hasten operation.

3. The less we disturb ourselves regarding the appendix, the happier we will be. There very seldom exists, in the condition we are discussing, an abscess where the appendix does not form a part of, and is well incorporated in nature's wall of omentum, cecum, and frequently intestine. Any attempt at removal will only increase our risk of breaking down this wall and, consequently, spread of infection. If the appendix is easily visible, and rarely this occurs, a simple ligature, before removal, with no attempt at inversion or pursestring of cecum, will suffice; and how well you know our fecal fistula's cure.

4. We make the peritoneal approach as wide as possible, consistent with the area in contact with the parietal peritoneum. After the abscess cavity is opened, a thorough aspiration, with removal of all detritus, enteroliths, and sloughing, loose tissue, is advised. The drainage must be so adapted that no back pressure exists to favor any accumulation of pus, distending the cavity, which we wish to collapse. For only by coaptation of the walls can we hope for granulation tissue to form, with subsequent obliteration. Now glass

and hard rubber tubing, with their well-recognized complications, have long been discarded for soft, flexible rubber drains or tissue. The cause of secondary and recurrent abscess is often premature closure of peritoneum at the site of incision, before nature has ample time for obliteration. Therefore, soft tissue drains are used until the rush of serum, following relief of tension, has subsided. Frequent dressings, at six-hour intervals the first and second days and once daily beginning the third or fourth days, following operation; a forceps inserted down to and through the peritoneal level, with gentle divulsion of opening in the peritoneum, will keep the cavity open. If, in this procedure, pus wells up under pressure, either our drains have been removed too soon, or there is obstruction, which should be remedied by mechanical means. Frequent postoperative aspiration with syringe and tubing is not bad practice, and often removes obstructions that are due to sloughing tissue.

Our drains should pass easily into the cavity, with no constriction or pressure from surrounding muscle. If after the incision we find a tortuous tract leading down to our pathology to be drained, our approach has not been direct, and we may expect trouble. There is a general tendency to leave drains in too long. It is mechanically impossible to obtain obliteration of any cavity with a foreign body between granulating walls. If there is a wide opening, with free exit from a cavity, drains are unnecessary and often obstruct, and consequently an accumulation and back pressure are established, with reabsorption and elevation of temperature. We, therefore, remove all drains as early as possible, when wounds are wide open, often on second or third day, and follow their removal with frequent stretching of the peritoneal incision. Gravity and favorable bed posture are important to maintain. Moist dressings are of no benefit if dry gauze is changed frequently, and only favor maceration and skin infections;

vaseline gauze will protect against skin infections.

5. An incision without sutures produces, we find, the most gratifying postoperative abdominal wound. In draining abscesses, there is no benefit derived from passing sutures through an infected field, out into a non-contaminated muscle fascia or skin. All tissue through which they travel is immediately infected, and furthermore, when tied, they obliterate the space, which you want wide open for drainage. Sutures do nothing curative, but are an added menace, favoring extension of infection under the skin, fat, and fascia outside of our incision. If our fascia and muscle approach to an abscess is too wide, and we are afraid of postoperative evisceration, adhesive splints, not on the anterior abdominal wall, but applied from the posterior lumbar region, well back to the spine, fixed anteriorly with tape or safety pins, give far more support than any suppurative stitch applied in the fascia or muscle.

6. Provided the appendix is not removed by ligation at the cecum, a secondary operation for appendectomy is imperative. Schneck at Urban Hospital, Berlin, in his review of 382 cases of surgically treated appendiceal abscess, had an incidence of 15 per cent recurrent appendicitis, which speaks, unquestionably, in favor of secondary appendectomy. A period of two or three months should elapse after drainage ceases, the nature's removal of all latent potential infected tissue, favoring clean secondary operation.

Deuttman accepts the opinion held at the Giessen Clinic, regarding the two-stage operation, and has abandoned the one-stage radical procedure. In 367 cases

treated solely by incision of the abscess, there were only 3 deaths, a mortality of 0.8 per cent of 314, or 86 per cent, of the patients who come to secondary operation, only one died, a mortality of 0.3 per cent. The total mortality was, therefore, 1.09 per cent which is very low compared with the one-stage, which averages 10 per cent or better.

For six months in 1925 and 1926, I was operating on approximately one-fifth of all emergency cases at the Los Angeles General Hospital, and personally operated on 11 cases with a postoperative diagnosis of walled-off appendiceal abscess, the histories of which I have obtained. The shortest time following an acute attack before operation was six days, and the longest, twenty-one. Hospitalization ranged from sixteen to thirty-seven days, with an average of approximately twenty-four and one-half days per patient. In 9 of these cases the appendix was left in, and was removed in 2 cases. In the 9 with the appendix left in, only one shows a record of secondary appendectomy; although all were told the appendix was not removed, and necessity for appendectomy was explained. There were no deaths, and wounds were essentially healed.

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# CASE REPORTS.

## CASE REPORTS BY DR. CHAS. MURRAY GRATZ\*

NEW YORK

### FRACTURE OF THE FEMUR AND INTERNAL CONDYLE OF THE TIBIA

MISS C. F., aged twenty-two, was first seen in consultation with Dr. C. P. Hussey and Dr. F. J. Schwartz on February 7, 1927. The history was that she had been injured in an automobile accident on October 6, 1926, sustaining a fracture of the left femoral shaft at the junction of the middle and upper thirds, and also a fracture of the upper extremity of the left tibia, the line of this fracture extending obliquely from the lateral half of the upper articular surface downward and inward through the cortex of the inner surface just below the condyle. These fractures had been treated from the time of the accident until the time of examination by means of traction apparatus, Thomas splints, and ice tongs. The use of the latter had resulted in suppuration at the point of their application over both condyles of the left femur. There was absolute non-union of the fracture of the femoral shaft. Motion of the knee was limited to  $10^{\circ}$ , in a position just short of complete extension.

Open reduction was decided upon, and the patient was operated on at the Post-Graduate Hospital February 10, 1928. After anesthesia, she was placed upon the Albee table, with both legs fastened in extreme abduction. Incision was made on the lateral aspect of the thigh, extending 6 in. below and 3 in. above the point of fracture. Muscle tissue was found interposed between the bone ends, which probably accounted for the non-union. With the Albee saw using a twin-blade a 4 in. graft was taken from the lateral aspect of the lower fragment of the femur and a 2 in. graft from the upper fragment, care being taken to have the two fragments in perfect alignment. The graft from the upper portion of the femur was discarded, and the one from the lower fragment was slid across the point

of fracture and held in position by kangaroo tendon after the Albee technic. The wound was then closed in the usual manner, both

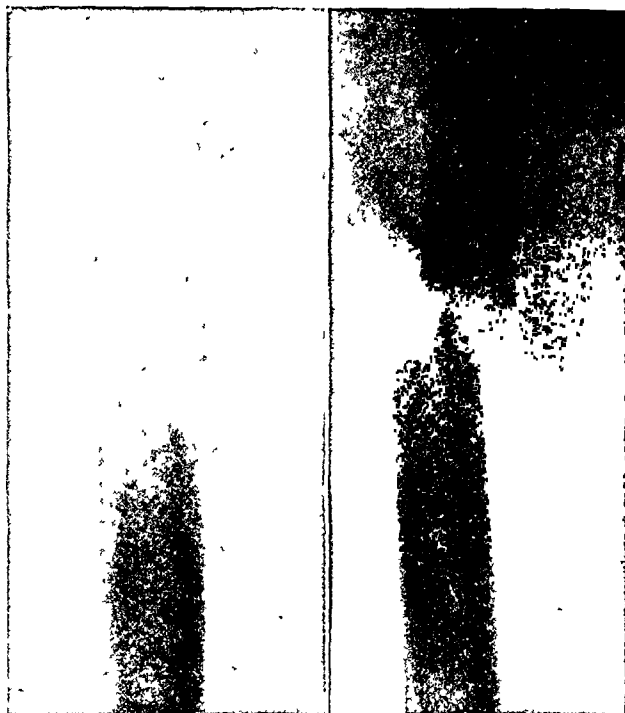


FIG. 1.

FIG. 2.

legs being sustained in wide abduction. The points of suppuration over the lower condyles of the left femur were carefully cleaned and iodine applied. Immobilization was obtained by means of a double spica, including the entire left leg and the right as far as the knee. The left knee was kept in extension and the cast was moulded to support the fracture through the upper portion of the tibia. The patient made an uneventful convalescence.

Radiographs taken through the cast on March 9, 1927, showed the bone graft in position and the fragments in perfect alignment. The cast was cut and the portion to the left leg removed on March 30, 1927, the entire cast being removed on April 4, 1927, and radiographs again made (Fig. 3). At this

\* Read before the Section of Orthopedic Surgery, New York Academy of Medicine, 1929.

time the wound was found to be in perfect condition, the legs straight, only  $10^{\circ}$  of motion in the left knee, and the area of suppuration

able to swim and dance without difficulty, and she had discarded all supports, even a cane, since January 1, 1928.

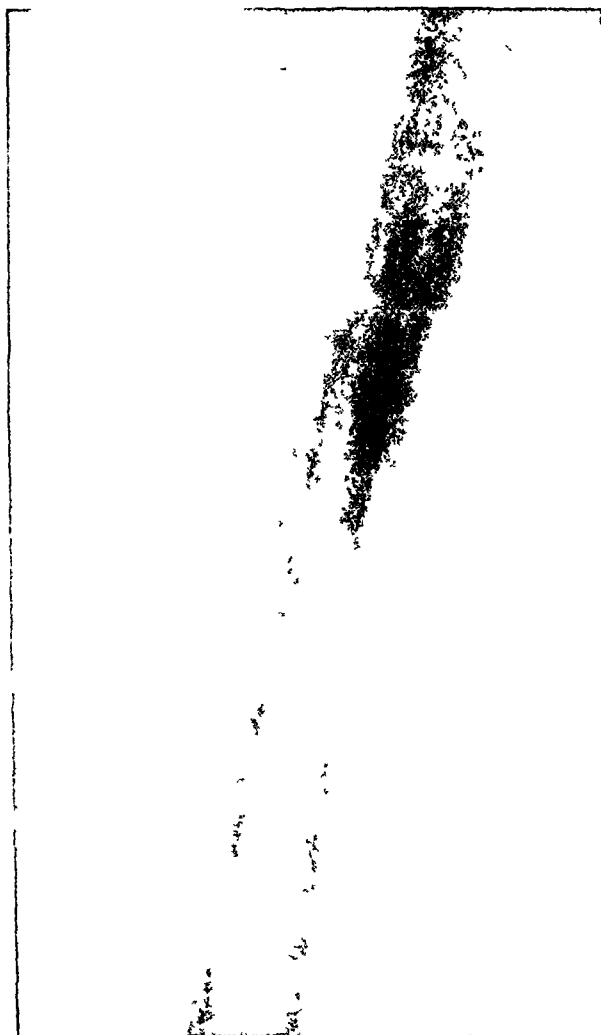


FIG 3.

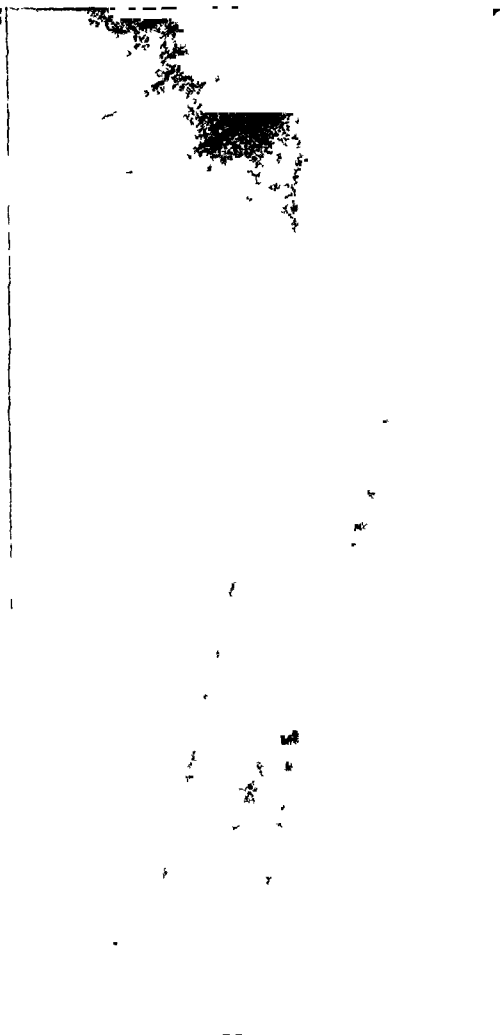


FIG 4.

over the condyles had improved. Massage was started, and the posterior portion of the cast was left in place until the patient left the hospital, April 23, 1927, with firm union of the fracture of the femur but limitation of motion in the left knee.

The next problem was to restore motion to the left knee. Massage and gentle manipulation was employed with slight improvement until July 25, 1927. At this time it was considered that the femur was sufficiently strong to permit manipulation of the left knee without danger. Accordingly an anesthetic was given and the knee manipulated until it was found that normal motion could be obtained. This was followed by massage, and the patient made an uneventful convalescence.

When seen on September 29, 1928, she was

### POTTS' DISEASE TREATED BY MULTIPLEX GRAFT TECHNIC

THE patient, L. B., aged twenty-four, had suffered for many years from an extreme kyphosis of the mid-dorsal region due to tuberculosis, and finally developed a psoas abscess.

The technic used in this case is especially adapted for cases of marked deformity of the spine in which immobilization by tibial grafts of the spinous processes is desired. In many such cases it is not possible to secure a single graft of sufficient width to accommodate itself to the degree of kyphosis.

Four grafts were taken from the tibia, being cut sufficiently thin to permit their adaptation to the extreme kyphosis presented.

These were placed at right angles to the direction of the split spinous processes, the periosteum and medullary sides being alternated, and were firmly fastened in position by kangaroo tendon. The trapezius muscles were lapped over one another in order to prevent any tendency to straining of the grafts; the grafts were also placed one beneath the other from above downward, thus giving the maximum thickness over the point of greatest kyphosis and securing a leverage action, tending to give firm immobilization of the diseased area.

The history was typical of tuberculosis of the dorsal spine; the kyphosis had reached an angle of about  $45^\circ$ , and a psoas abscess had developed and discharged for about six months previous to the operation. An x-ray examination showed destruction of the 5th to the 12th dorsal bodies.

The operation was done on October 26, 1926. On November 21, 1926 a postoperative x-ray was taken, after which the patient was allowed to sit up. The psoas abscess discharged intermittently until November 19, 1927, but has not recurred since that date. No casts or braces were used at any time.

At the time of presentation the patient was free from any discomfort and was able to live a normal life.

#### DISCUSSION

DR. FRED H. ALBEE: Dr. Gratz is to be congratulated on the results of the technic applied in this case. In such a case with dorsal region when the kyphosis is so markedly angular the spinous processes have separated widely and in as much as the diameter of the spinous process is small, the amount of bone available locally is most inadequate even though it might have inherent active osteogenetic potentiality. This, however, is not the case as we have every evidence the vertebral bone has a lower osteogenetic potentiality, as shown clinically by the frequent absence of repair following both disease and trauma in all portions of the vertebrae. Spies has pointed out that a fissure fracture of the articular process rarely unites and recommends operative fusion. Union of fractional lateral or spinous processes is the exception rather than the rule. The frequency of unsatisfactory repair or even complete failure of repair of a fractional or crusted vertebral body is well known, absorption or recession of bone frequently continuing long after the trauma.

I tested experimentally this relative osteogenesis at Cornell Experimental Laboratories in 1910 and 1911, by taking blocks of bone of equal size from the spinous processes and ulnae of dogs, and incorporated them in various parts of the body of the dog, and I found a marked difference in the growing ability of the different types of bone, the vertebral bone being far below that of ulna bone. In such cases as this above all others, I believe we need additional bone, and bone of a higher osteogenetic potentiality than that of the vertebral bone.

As to the technic, in putting in grafts over a kyphosis as extensive as this, there are only two ways: one by the carpenter's method of bending a board about a rounded corner. He first makes numerous saw cuts most the way through the board on what is to be its concave side. Lateral tension then causes each saw cut to close at the concave surface of the board as it bends. The multiplication of saw cuts allows the bone to bend about a very pronounced kyphosis. In later years I have changed this method, by making the most of the bundle of reed principle and thus make the grafts very thin, cutting the bone from the tibia in thin strips and laying them somewhat as Dr. Gratz has indicated.

DR. LEO MAYER: This is one of the most marked kyphoses we have ever seen at the Post-Graduate Hospital, amounting to almost  $180^\circ$ . Having tried in curves of a lesser grade to put in bone grafts, I realize how difficult it is to get a graft that will really hold. I would like to know from Dr. Albee and Dr. Gratz whether the alternative method of shaping grafts by multiple saw holes would fit a curve of this degree.

DR. ALBEE: I would refer Dr. Mayer to a case in my last book<sup>1</sup> where the kyphosis was very nearly as great as this, with the graft in place, but it is a very much more difficult operation than this, and I would recommend this one.

DR. GEORGE ANAPOL: I had a case of acute kyphosis, I believe a little more acute than the one presented, where I used three pieces of bone, making a bracket, so that the upper graft goes in the upper leg of the angle, the second in the lower leg, the two meeting at the point of kyphosis, and the third or thinner one coming between the two at about  $45^\circ$ .

<sup>1</sup> Albee, F. H. *Orthopedic and Reconstruction Surgery*, Phila., Saunders, 1919.

thus getting the bracket formation. The apex, of course is filled with bone, and thus we have a similar mechanical condition to the one Dr. Gratz has worked out with the curved graft. This case is of twenty-years' duration. Since the graft operation the sinus has healed. That is another method of helping these acute angular conditions.

DR. GRATZ: I was particularly gratified by the end result for we got a very firm fusion, which showed that the pathology had completely cleared up.

As to the operative time, it was forty minutes. I am certain that if any fusion other than by bone graft had been done the patient would not have stood the operation.



## TRANSPLANTATION OF THE URETER INTO THE BOWEL\*

ROBERT E. KINLOCH, M.D., F.A.C.S., AND LEO S. DREXLER, M.D.

BROOKLYN, N. Y.

ENCOURAGED by the work of Coffey, Peterson, Furniss and others, who have recommended the implantation



FIG. 1.

of the ureter into the large bowel for incurable vesicovaginal fistula, as well as in tuberculous ulcerations of the bladder with a good remaining kidney, we are reporting a case where several attempts at plastic repair were unsuccessful and where employment of this procedure brought relief after years of suffering and a cure of her condition.

T. H., colored, aged forty-seven, was admitted to the Urological Service of the Cumberland Street Hospital with a diagnosis of vesicovaginal fistula. Her chief complaint at the time of admission was an inability to control her urine. She had been married for fourteen years and had never had any children. There was a history of three miscarriages in the early months of pregnancy. The family history was essentially negative, there being no history of tuberculosis in any of her family. She had had whooping cough and measles during childhood and an attack of rheumatic fever at the age of fifteen. There was no history of pulmonary disease. Her trouble began ten years before admission with frequency and burning on urination.

She entered the Johns Hopkins Hospital at that time, where a diagnosis of right tuberculous kidney was made and nephrectomy advised. She refused operation and was discharged.

Five years ago her symptoms became aggravated, she entered Bellevue Hospital on May 29, 1924 and a right nephrectomy was performed. The pathological report confirmed the diagnosis of tuberculous kidney. However, she had very little relief and in addition, three years ago she began to wet herself. She became progressively worse and soon found it impossible to control her urine at all and with this complaint she entered our service on December 26, 1928.

Physical examination revealed a fairly well-nourished individual. Examination of the head and neck was negative; breath sounds were everywhere vesicular in character; no

\* Submitted for publication August 15, 1929.

râles heard. The abdomen was soft, no masses were palpable; scar of right nephrectomy noted.

The bladder was filled with methylene blue and the fistula visualized. The fistula was found to be rather large with rigid walls.

On January 8, 1929, under spinal anesthesia, an attempt was made to repair the fistula through the vaginal route. Following this there was no leakage for about ten days. The area appeared well healed and we were about to discharge her when she again began to dribble urine.

On January 30, a second attempt was made to repair the fistula; this time by the suprapubic route. The fistula was visualized, resected and closed. The bladder on inspection showed signs of multiple ulcerations, apparently tuberculous in character. A suprapubic tube was inserted and the wound closed.

In spite of this, leakage through the vagina continued and the patient expressed a desire to have something done which would give her relief. A transplantation of the remaining ureter into the bowel was decided upon and performed on February 26, following the

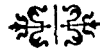
technic of Coffey. There was little postoperative discomfort. Fairly clear urine was seen to flow continually from the in-dwelling ureteral catheter. There was no abdominal distention.

On March 1, a left parotitis developed which was subsequently incised and drained. On the eighth day postoperative, the ureteral catheter came away. On the eighteenth day postoperative, there was a rise in temperature to 103°F. which lasted for one week and was associated with some tenderness over the left kidney.

From then on, her convalescence was uneventful. She has no difficulty in controlling her urine, voiding every three hours during the day and seldom during the night. Her chemistry one week before her discharge was:

Blood sugar.	..	89.2
Urea.	..	23.8
Uric acid	.	4
Creatin.		1.6

Beside x-ray six days postoperative shows ureteral catheter in place draining through rectum.



## ARTHRODESIS FOR FLAIL WRIST\*

SIGMUND EPSTEIN, M.D.

NEW YORK

THE patient was fifteen years old in January, 1928. He had had infantile paralysis in 1916, and the right arm became paralyzed and useless. He came in with cubitus varus and a flail-like useless arm, with retained power in the biceps and trapezius only. The wrist was characterized by marked supination; his pronators had been put completely out of action by the infantile paralysis, inducing a markedly excessive hyper-supination deformity of the forearm. His hand went back another 45° by curvature of the radius, so that the palm was pointed backward, that is, the thumb pointing toward the center of the body. This produced marked insecurity.

On January 29, 1928, I did a preliminary stretching, putting the hand in pronation in plaster-of-Paris. On March 15, 1928, an arthrodesis was done. The patient now has

a member which he can use for holding objects. Before operation, anything that was put on the palm of the hand fell off; now he can use the hand for grasping objects and bringing himself toward the flexed, grasping hand. He can now catch and pitch, which is a desirable function, and can lift objects with his hand, due to the stabilized wrist.

There is nothing extraordinary about the case, except that there have been very few operations of this sort demonstrated here since Dr. Arthur Steindler was here; but the patient now has a more useful hand than before, partly owing to the fact that the stretching has proved so useful in the preliminary treatment.

The method of arthrodesis was: A dorsal incision, disclosing practically no

\* Read before the Section of Orthopedic Surgery, New York Academy of Medicine, May 17, 1929.



useful tendons, was made. The cartilage was simply peeled off the carpal bones wherever we found it by means of a knife; it was soft and easily separated, leaving a mass of pulpy cancellous short bones and bony cancellous medulla of the long bones of the radius and metacarpus. We then impacted these together in as good a position as we could get, which resulted fortunately in the extended position the boy now has. No graft was used.

#### DISCUSSION

DR. BOORSTEIN: Was anything done to shorten the tendons of the wrist? They must have been quite long on account of the flexed position.

DR. R. E. HUMPHRIES: We have operated on several of these flail arms at the New Jersey Orthopaedic Hospital in Orange and have found that an arthrodesis such as Dr. Epstein describes gives very favorable results in controlling deformity of the hand and also in restoring usefulness. The results are not as uniformly good as an arthrodesis of the foot but a fair percentage of excellent results may be expected.

DR. ARMITAGE WHITMAN: Dr. Humphries spoke of the comparative results in the treatment the upper with the lower extremities. A friend of mine had complete paralysis of the upper extremity. He came to me one day and said: "I have found a miraculous Swede in Boston who has been working on me with massage." I asked him: "What can you do now that you could not do before?" and he moved his thumb over to approximate his

little finger. And when I enquired as to the practical importance of an apparently insignificant movement he replied, "Well, I can now hold a bit of bread in my hand; I could not do that before. Now I can also hold a cigarette." These small improvements are very important and emphasize the great difference in the estimation of results between the upper and the lower extremity. In the lower extremity a muscle to be of functional importance must be practically normal. Whereas in the upper extremity the slightest movement may be of great value.

DR. EPSTEIN, *Closing*: At the first view of these tendons on the wrist one was struck with their excessive tenuity. There was no action to any of the tendons; they were flabby, thin, yellow, did not appear to be of much help in the way of transplantation work with any of them. I might have done some transplantation, but I have much more faith in bone operations than in questionable tendon operations. Dr. Whitman's remarks were very pertinent to this case. The boy regained a fair amount of power in the long flexor of the thumb. He can hold a fairly large object between the first finger and thumb; this has been developed since his operation. He had deformity at the metacarpal phalangeal joint of marked extension, and I was anxious to do an osteotomy across all the metacarpals for the purpose of increasing the flexion, but that is another thing that is improving since the operation; he has opened up a wide range of motion and can do much more with his fingers because the adhesions have been overcome and he has more power in the intrinsic muscles; but the muscles on the back of the wrist offered very little hope for any sort of operative work.



# FRACTURE OF LATERAL CONDYLE OF FEMUR ASSOCIATED WITH TEARING OF ANTERIOR CRUCIAL LIGAMENT\*

LEWIS CLARK WAGNER, M.D.

NEW YORK

**O**STEOCHONDRAL fractures are by no means rare and after a thorough review of the literature one finds a great amount to be written on the subject. This type of fracture associated with ligamentous tear no doubt has been observed on many occasions but no definite report of cases made.

**Classification.** The etiology is always associated with definite trauma where there have been both external factors and muscular violence. The fracture of the articular surface of the femoral condyle (lateral) is the direct result of the factors, which tend to rupture the anterior crucial ligament. The direct factor in the cases described below was the individual being thrown or falling on the partially flexed knee. This was accompanied by violent rotation and forcible extension of the knee as the patient attempted to reestablish his equilibrium. Stretching of the anterior ligament is imminent after such trauma and if the force is great enough, tearing, or even rupture of the ligament, is certain; while if the cartilage or bone of the joint is of adolescent type there can be an associated osteochondral fracture. A. T. Fisher states this condition can be easily artificially produced in the fetus.

**Pathology.** When one explores the knee joint so affected there is always a moderate degree of synovial hypertrophy. The torn surface of the anterior crucial ligament and displaced bony fragment (which is usually wedge shaped and measures about  $1 \times 1.5$  cm.) have acquired an attachment to the synovial membrane. There is a y-shaped tear of the anterior crucial ligament, the uppermost part still attached to the fragment and the lower part in situ. The osteochondral fragment may be

dislodged and find a new attachment on the anterior surface of the lateral femoral condyle. The original site of fracture may

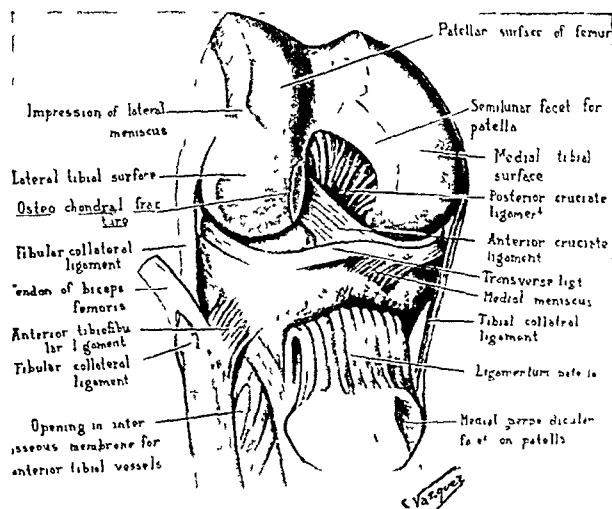


FIG. 1.

be covered completely with new cartilage but a small depression is still noticeable. One finds no necrosis in the dislodged osteochondral fragment but usually a proliferation of bony substance has taken place.

**Clinical Classification.** This type of fracture is very rare and occurs most frequently in the adolescent age. It has not so far been noted past twenty years of age. Its occurrence has been noticed but five times in the careful study of 4873 knee conditions, extending from the year 1880 to 1929 as taken from the private files of the late Dr. Virgil P. Gibney and myself.

The symptoms are marked by the absence of pain. Every knee injury in a young adolescent should be investigated with respect to a ligamentous tear associated with fracture. The line of fracture sometimes becomes distinct after walking has been started following an injury. The

\* From the 3rd Surgical Division of the Hospital for the Ruptured and Crippled. Submitted for publication September 7, 1929.

patients walk with a slight limp and there is also a slight tendency to knock-knee, which is due to a partial rotation and sub-

*Treatment.* The ideal treatment as soon as the diagnosis is established is surgical. The knee joint is explored through a

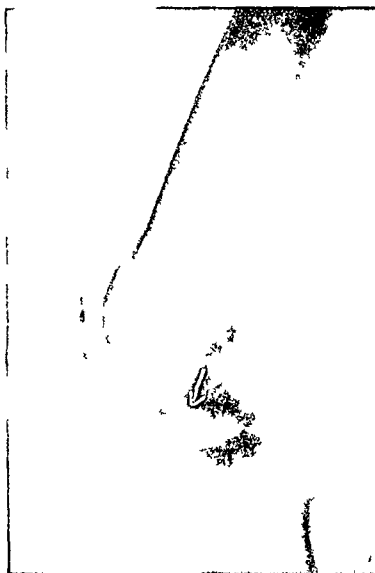


FIG. 2.



FIG. 3.

luxation of the knee joint. Extension is always limited and flexion is limited beyond a right angle. One finds no increased lateral mobility.

medial incision and a thorough inspection of the joint is made. The osteochondral fragment is easily removed with a small chisel. The attached part of the anterior



FIG. 4.



FIG. 5.

*Diagnosis.* The physical signs are quite similar to those of a loose body in the knee joint and a true diagnosis can only be made by roentgen ray.

crucial ligament is excised and removed with the osteochondral fragment, after which the knee is forced into complete extension.

## REPORT OF CASES

CASE I. (Dr. Wagner.) Miss M. W., aged fifteen years, was seen March 31, 1924 and



FIG. 6.

gave a history of being thrown from a bicycle and injuring the left knee four weeks previously.

170°. There was no tenderness. Roentgenograms revealed a slightly displaced forward fracture of the external condyle with no callus formation. Arthrotomy was performed on April 8, 1924 and the fragment removed. There was only fibrous union. A part of the anterior crucial ligament which was attached to the fragment was excised. Extension was readily executed without further manipulation. The convalescence was uneventful. Walking began on the tenth day and physiotherapy was given on twentieth day. Examination in March, 1925 showed no deformity and full range of motion.

CASE II. (Dr. Wagner.) Miss A. D., aged nineteen, was seen September 10, 1925, because of deformity of left knee and incomplete extension. She gave a history of falling upon the flexed and adducted knee while dancing the tango. The accident happened in October, 1923. There was some difficulty in getting the knee straight. The family physician applied a splint, which was left on two weeks. Roentgenograms revealed a fracture of the external condyle with slight displacement. Massage was instituted and walking encouraged. Motion slowly returned but there was never complete extension and had become less in the past year. Examination of the knee revealed no fluid or tenderness.

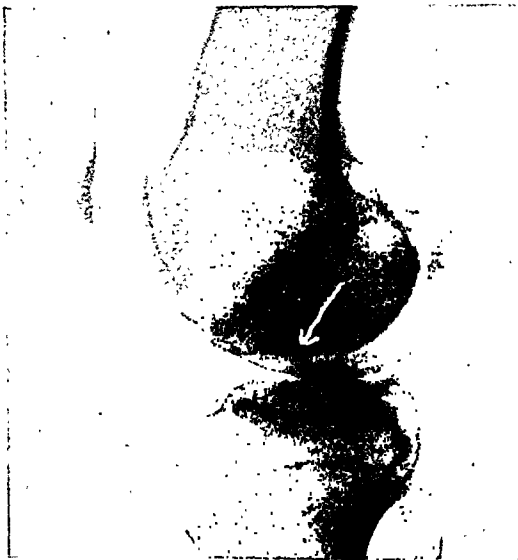


FIG. 7A.



FIG. 7B.

It had been treated with adhesive strapping but full extension did not return. Examination was negative except for the left knee. Flexion was normal but extension was limited at

Extension was limited at 170° and flexion 90°. There was a slight knock-knee. Measurements: R. thigh 16 in. R. knee 13½, 13½, 12 L. thigh 15 in. L. knee 13¼, 13, 11½.

Roentgenograms showed a displaced fracture of the external condyle between the joint surfaces. There is no absorption of the fragment and there seemed to be union to the anterior surface of the femoral cartilage. This fragment is evidently the opposing factor, which prevents extension. Arthrotomy was performed October 1925 and the fragment removed with attached part of anterior crucial ligament. The original site of fracture from which the fragment had been dislodged seemed to be covered with cartilage. The knee was forced into complete extension but not placed in plaster. Walking was begun on the tenth day and physiotherapy at the end of three weeks. Final examination December 1928 shows complete function. Measurements are the same and no pain.

CASE III. (Dr. Gibney.) A boy, twelve years of age, was seen November 14, 1911, with a complaint of limitation of motion and pain in the right knee. Two years previous he had fallen while playing tennis and injured the knee. He was forced to stop playing because of extreme pain and immediate swelling. He was put to bed and treated by means of ice bags. At the end of two weeks he had a fair range of motion and was allowed to walk. The pain soon disappeared and function returned, except for complete extension. Examination was negative except for the right knee. There was a slight enlargement of the knee. Motions were good except extension was limited at  $170^{\circ}$  and flexion at  $95^{\circ}$ . There was moderate swelling in the popliteal bursa and under the ligamentum patella. Roentgenograms showed a small fracture of the external condyle and a fragment pushed forward and inward. There seemed to be union in the new position of the displaced fragment. Arthrotomy of the right knee was performed by Dr. Gibney in January 1912 and the fragment removed. Plaster was applied with knee in full extension, which was worn six weeks because of associated synovitis with the original injury. Examination two years later showed no difference in the knees.

CASE IV. (Dr. Gibney.) A man, aged twenty-one, came under observation April,

1914 with a history that five years previous he had injured the right knee alighting from a buggy and was incapacitated for a month. Plaster-of-Paris was employed at the onset and on removal he was encouraged to walk. Motion returned but the knee could never be completely extended and at times after exertion it would become painful. Examination was negative except for the right knee. There was slight atrophy about the right knee and thigh. Extension was limited at  $165^{\circ}$ . Flexion was limited at a right angle. There was no particular tenderness about the cartilages and the patella was movable. Roentgenograms of the right knee showed an old mal-united fracture of the external condyle of the femur, which had become pushed forward and impinged upon the tibia in extension. Arthrotomy was performed on April 30, 1914 and the fragment removed. The knee was encased in plaster with the knee in full extension. Motion was started at the end of three weeks. At the end of six months there was complete function of the right knee and no pain.

CASE V. (Dr. Gibney.) A young man, eighteen years old, was seen on March 7, 1892 with a complaint of incomplete extension of the left knee. He gave a history of missing his footing while turning a somersault, adducting the leg. He experienced extreme pain and was carried home. The knee became promptly swollen and was treated with ice bag and a posterior splint. Walking was encouraged at the end of a month. Examination nine months after injury showed extension of left knee limited at  $150^{\circ}$  and flexion at  $85^{\circ}$ . Measurements were not increased. A diagnosis of incomplete dislocation of the semilunar cartilage or loose body in the joint was made. On March 18, 1892 the knee was manipulated and forced into extreme extension. Plaster was removed at the end of six weeks. There are no further progress notes in the history. I assume in reviewing the records of this case that it was one of *fracture of the external condyle but was not recognized because roentgenograms had not been used prior to 1897 and arthrotomy was not performed in those days except for exceedingly urgent reasons.*



# BLADDER DIVERTICULUM COMPLICATED BY CARCINOMA OF CLOACAL ORIGIN\*

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CARCINOMA occurring in a bladder diverticulum, while not a surgical rarity, is perhaps sufficiently out of the ordinary to warrant the recording of individual cases. The case which I am about to report presented a few factors in connection with the clinical history and pathological findings which merit attention.

The patient was a male, single, salesman, aged forty-eight, first seen on July 21, 1926. He had gonorrhea once in youth. This lasted several weeks; there were no complications and he thought he was cured. At the age of thirty-seven he was operated upon for duodenal ulcer. He made a good recovery and has had no digestive trouble since.

His present trouble began four years ago with a sudden severe pain referred over the sacrum extending through to the hypogastric region. A local physician who was called in found a distended bladder and catheterized him with prompt relief from his pain. Since that time he has been catheterizing himself two or three times daily and has not at any time voided any urine naturally. About one year before he had been examined by another urologist, told that he had a diverticulum and operation advised. Examination disclosed an individual rather underweight and somewhat cachectic in appearance. General physical examination was otherwise essentially negative. The prostate gland as palpated by rectum was slightly enlarged and a feeling of fullness was noticed above it. A soft rubber catheter passed easily into the bladder and 12 oz. of very foul cloudy urine were evacuated. He was advised to go in the hospital for further investigation and probable operation. We did not see him again until June 19, 1928, about two years later. In the meantime he had been keeping himself reasonably comfortable with regular catheterization until two weeks ago, when the urine became bloody. The findings were much the same as at the previous examination and this time 16 oz. of bloody foul urine were evacuated. Hospitalization was again

advised and declined. He reported at irregular intervals for bladder lavage until September 18, 1928, when he finally went to the hospital.



FIG. 1. External appearance of diverticulum.

Cystoscopy on September 22 was rather unsatisfactory because of inability to secure a clean medium and because of very heavy folds in the bladder wall which could not be ironed out with the distending medium. However we noticed what we assumed to be the opening of a diverticulum in the port wall just above the trigone and mesial to the right ureteral orifice. The prostate encroached very slightly on the bladder neck.

A cystogram was made and the radiologist reported as follows: Cystogram shows an irregular bladder. Its under, posterior and upper surfaces on the right side are irregular and it has the appearance of being segmented. If this segmented aspect is due to a diverticulum it is a very large one. It might be due to growth practically dividing the bladder and the irregular appearance of the bladder would suggest tumor either intrinsic or extrinsic. The phenolsulphonephthalein output

\*Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, April 24th, 1929.

showed 20 per cent the first hour, 15 per cent the second hour and 5 per cent the third hour.

The blood chemistry was as follows: urea

It was enormously enlarged and its wall was about  $\frac{1}{2}$  inch thick. There was a huge diverticulum almost entirely filling the true



FIG. 2. Diverticular cavity lined with smooth epithelial lining of epidermoid type. In lighter areas wall of diverticulum is infiltrated by carcinoma of epidermoid type.

41.4, creatinin 3.57, sugar 138.8;  $\text{CO}_2$  combining power 56.5. The concentration test showed a variation from 1008 to 1015.

pelvis, with its opening on the posterior wall just above the trigone and mesial to the right ureter. Surrounding the orifice there was a



FIG. 3. Epidermoid carcinoma lining diverticular cavity.



FIG. 4. Large glandular structures with numerous goblet cells. Lumen of gland is filled with mucus.

*Operation* September 28, 1928: Median incision from symphysis to umbilicus. The bladder was exposed and freely mobilized.

papillary growth apparently arising from the cavity of the diverticulum and extending down on the trigone toward the internal

meatus. The bladder wall around the orifice appeared to be moderately infiltrated. At this time there was some doubt as to whether anything short of a total cystectomy would suffice, chiefly because of the proximity of the infiltrating area to the sphincter. We finally decided upon excision and resection, which was done, hugging very close to the ureter orifice and also the internal sphincter. There was some doubt in our mind at the time as to whether we had gotten sufficiently wide of the growth. The usual closure was made around a suprapubic tube and ample extravescical drainage. The operation was prolonged and extremely difficult because of dense adhesions to the diverticulum and the patient left the table in rather profound shock from which he rallied quickly with the usual treatment.

The pathological report was as follows:

**Gross.** The material consists of two large pieces of thickened bladder wall and a large diverticular pouch 8 cm. long and 6 cm. in diameter. This is shaped like a parabola. It is lined with a smooth gray membrane. The opening of the diverticulum in its fixed state is about 4 cm. in diameter. The margins of the opening are firm and white on section and along one margin of the opening some shaggy tumor-like material projects into the cavity of the diverticulum.

**Histological.** Sections show the diverticular cavity lined with malignant tumor of epidermoid type and this accounts for the gray color of the internal surface of the pouch. There was also in the wall of the diverticulum and close to the internal surface, clusters of adult intestinal glands. Deeper in the wall there are large loculi of mucus, surrounded in places by epithelium of intestinal type and in others by tumor epithelium of epidermoid type. The microscopic details mentioned would indicate that the diverticulum and new growth originated in some maldevelopment of the cloaca in its formation of the rectum and bladder.

Four weeks postoperative the patient was apparently progressing favorably, except that his suprapubic fistula continued to drain and he would not tolerate an indwelling catheter. He went on in this way for another month, up and about the ward, but voiding only a little urine. At this time he began to fail

and rectal examination disclosed a huge mass in the pelvis, part of which I believe was inflammatory exudation and part a rapid



FIG. 5. Multiple collections of mucus surrounded by epidermoid carcinoma cells.

extension of tumor tissue following an inadequate operation. He died on December 7, 1928. Autopsy was not permitted.

The points of interest are: (1) another case of carcinoma arising in a bladder diverticulum; (2) this patient led an absolute catheter life for six years, with no gross demonstrable obstructive lesion, unless it be the direct presence of the diverticulum itself, and at operation there was noted an enormous hypertrophy of the bladder musculature.

It would appear to me that two factors may have operated: (1) the mechanical obstruction of the diverticulum and (2) some more indirect disturbance of the normal mechanism of urination which interfered with the opening of the sphincter muscle. The third point of interest is the pathological report. This is one of several bladder tumors of apparent cloacal origin which have occurred in our clinic and they are being subjected to a somewhat intensive study and will be reported on later by Dr. Fisher and Dr. Denton of our staff.



# DEPARTMENT OF RADIOLOGY

JAMES T. CASE, M.D., F.A.C.S., EDITOR

## ROENTGENOGRAPHIC EXAMINATION OF THE FEMALE PELVIC ORGANS\*

USE OF OPAQUE MEDIA FOR INTRAUTERINE INJECTIONS AND FORMATION OF  
PNEUMOPERITONEUM FOR GYNECOLOGIC AND OBSTETRIC DIAGNOSIS  
(FOURTH COMMUNICATION)

JULIUS JARCHO, M.D., F.A.C.S.

NEW YORK

ROENTGENOLOGIC examination of the female pelvic organs has passed the experimental stage and stood the test of time. Very few gynecologists can afford to be without this diagnostic aid.

### INSUFFLATION IN DIAGNOSIS

In 1919, Arthur Stein and W. H. Stewart<sup>1</sup> described their method of pneumoperitoneum for roentgenologic examination of the peritoneal cavity. Theirs was the pioneer work in this method in the United States. For insufflation of the abdominal cavity they<sup>2</sup> used an ordinary lumbar puncture needle inserted one to three fingerbreadths below the umbilicus in the median line. The gas was insufflated slowly from a rubber bag connected with the tank. Either  $\text{CO}_2$ , oxygen, or a mixture of the two gases was used depending on the length of time required for the examination. The amount varied from 2 to 4 liters according to the condition of the anterior abdominal wall.

In their original article Stein and Stewart<sup>1</sup> noted that, in the exaggerated lateral Trendelenburg position, the normal uterus with its ligaments can be demonstrated by pneumoperitoneum; also, cystic ovaries and myomatous tumors of the uterus. In a 1920 article they<sup>3</sup> stated that the uterus and its appendages are

shown in even better detail with the patient lying on the abdomen, head downward, on a table tilted at about 15 degrees.

In 1921, Rubin,<sup>4</sup> continuing his experimental findings of 1919, reported intrauterine insufflation of oxygen to determine the patency of the Fallopian tubes. His instrument included a manometer and flow volumeter for measurement of the quantity, flow and pressure of the gas.<sup>5</sup> If the tubes are permeable, there is a drop in pressure when the gas passes through the tubes into the peritoneal cavity. If they are not permeable, there is a steady rise in pressure and not more than 200 c.c. of gas should be introduced. This investigator<sup>6,8</sup> states that the patient should be fluoroscoped in the erect position after tubal insufflation, as this will show a single or a bilateral subphrenic pneumoperitoneum if one or both tubes are patent. In his later work he<sup>6</sup> has used  $\text{CO}_2$  instead of oxygen and has added a kymograph<sup>9</sup> to his apparatus for the graphic recording of variations in pressure during insufflation.

Peterson<sup>10</sup> in 1921 reported his use of Rubin's method for transuterine insufflation of gas. For roentgenologic examination<sup>11,12</sup> the patient is placed in the moderate knee-chest position with the table inclined, as for the Trendelenburg

\* Submitted for publication January 18, 1930.

position, at an angle of about  $20^{\circ}$ . If the tubes are permeable as shown by the drop in pressure after the initial rise, about

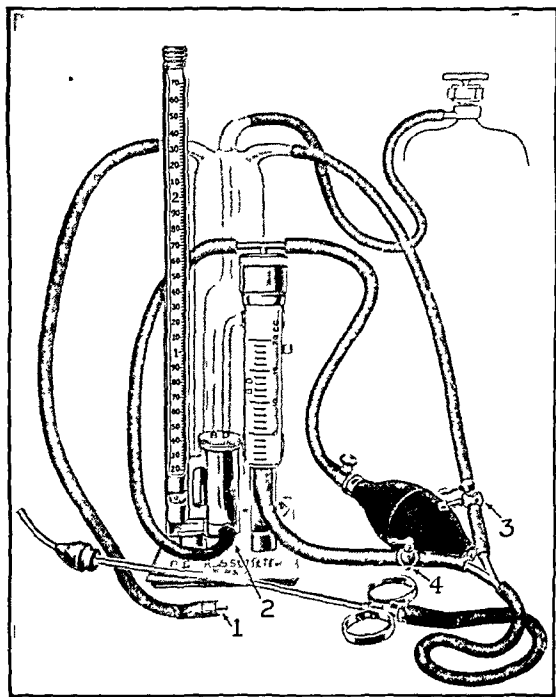


FIG. 1. Author's apparatus, the pressometer, for introducing air or opaque media into uterus, urinary bladder or kidneys, with a Machlett siphonometer for perabdominal and peruterine introduction of oxygen or carbon dioxide.

800 to 1000 c.c. of gas are allowed to flow into the peritoneal cavity. If they are not permeable, transabdominal insufflation is used, which is indicated also in acute pelvic disease and if there is purulent and bloody discharge. For transabdominal insufflation puncture is made with a spinal puncture needle just below the navel. The Rubin apparatus is used for the abdominal as well as for the transuterine route. Peterson at first employed oxygen but soon changed to  $\text{CO}_2$ .

Sage<sup>13,14</sup> also has produced pneumoperitoneum by both the transuterine and transabdominal routes for roentgenologic diagnosis in gynecologic conditions. He prefers the transuterine route if the tubes are permeable and believes the method of value because it "gives us definite information about the patency of the genital tract from the cervix to the ovary."

## INJECTION OF MEDIA OPAQUE TO ROENTGEN RAYS

More recently the method of utero-

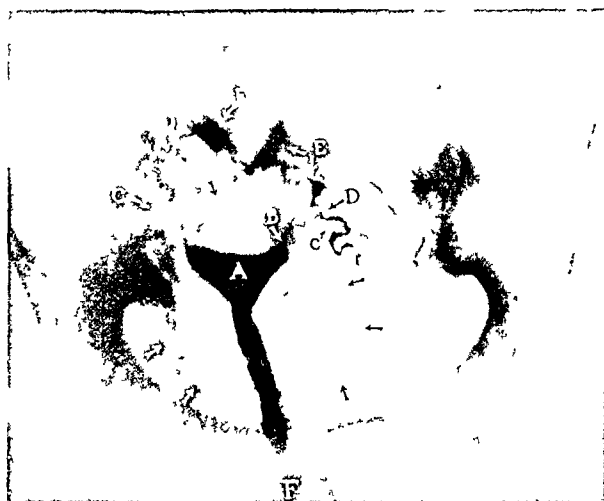


FIG. 2. Roentgenogram after peruterine injection of 900 c.c. of gas, followed by peruterine injection of 5 c.c. of iodized oil. The gas entered at a pressure of 180 mm. and dropped to 140 mm. Shadow of retroflexed fibroid uterus is outlined with six arrows. A. Triangular shadow of uterine cavity. B. Tubal sphincter. Note that sphincters are at beginning of interstitial portion of fallopian tubes and should therefore be called uterine, or still better cornual sphincters. C. Isthmus of tubes. D. Ampullae of tubes. E. Free oil in peritoneal cavity. In one place there is a droplet formation of oil in peritoneal cavity, indicating that there was fluid in tubes. F. Nozzle and volsella on cervix.

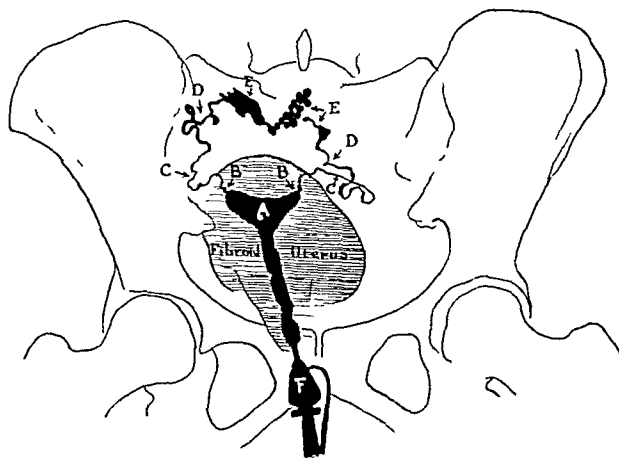


FIG. 3. Diagram drawn to illustrate various points in Figure 1.

salpingography by the introduction of various opaque media into the uterus and tubes has been developed, utilizing extensively the iodized oils: lipiodol, iodipin and lipiodine. These media have proved of great value in demonstrating normal

pelvic conditions, obstruction and disease of the tubes, tumors of the uterus and malformations; and in some cases they

They have also designed a new table for the examination.

In cases where intrauterine insufflation



FIG. 4. Roentgenogram after peruterine insufflation of 1400 c.c. CO<sub>2</sub> followed by peruterine injection of 6 c.c. of iodized oil. Shows fibroids involving entire uterus. Neoplasm extends mostly to left, encroaching on cavity of uterus as shown by filling defect in triangular shadow on left side. It also occludes left fallopian tube at cornual end. On right there are fibromata of various densities. Fallopian tube on right side is normal and patent. Small amount of oil entering into peritoneal cavity. Sphincter at proximal end of interstitial portion of this tube is well shown.



FIG. 5. Same patient as in Figure 4. Uterine cavity is emptying itself of oil into peritoneal cavity, where it is widely distributed. Irregularity of tumor is shown well in this plate.

have served as therapeutic measures as well.

In October, 1926, Stein and Arens, who<sup>15</sup> had previously employed pneumoperitoneum only for gynecologic diagnosis<sup>16,17</sup> described their combined use of pneumoperitoneum and iodized oil injections. This was the first time that such a combination had been reported, although each method had been used separately for some time and proved of value. Carbon dioxide was insufflated by Rubin's method and then 2 c.c. of iodized oil injected. The patient was then placed in the Peterson knee-chest position and stereoroentgenograms were made. Stein and Arens<sup>18-21</sup> have since perfected their method and have designed a new instrument for the combined intrauterine insufflation and iodized oil instillation, which is self-retaining and facilitates the postural changes necessary for roentgenography.

is contraindicated or where the tubes are not patent, they employ transabdominal insufflation for pneumoperitoneum. Carbon dioxide is used as a rule, except in a selected group of cases in which oxygen is employed. From their results these investigators<sup>21</sup> conclude that "the maximum information as to the genital status, short of surgical exploration, may be obtained by the combined method of pneumoperitoneum and iodized oil instillation."

Some gynecologists have resorted to both tubal insufflation and iodized oil injections, but not the combined method of pneumoperitoneum and uterosalpingography. Forsdike<sup>22</sup> in 1925 reported the use both of insufflation of the tubes to determine patency and of iodized oil injections for radiologic study of the uterus and tubes. He did not, however, resort to tubal insufflation for producing pneumoperitoneum nor did he combine the two methods at one examination, but injected iodized oil one week after the insufflation test was made. He used air for insufflation and measured the pressure and the flow.

Haselhorst,<sup>23</sup> likewise, had recourse both to tubal insufflation and to iodized oil

injection, but did not use these methods in combination. He employed tubal insufflation in cases of uncomplicated steril-

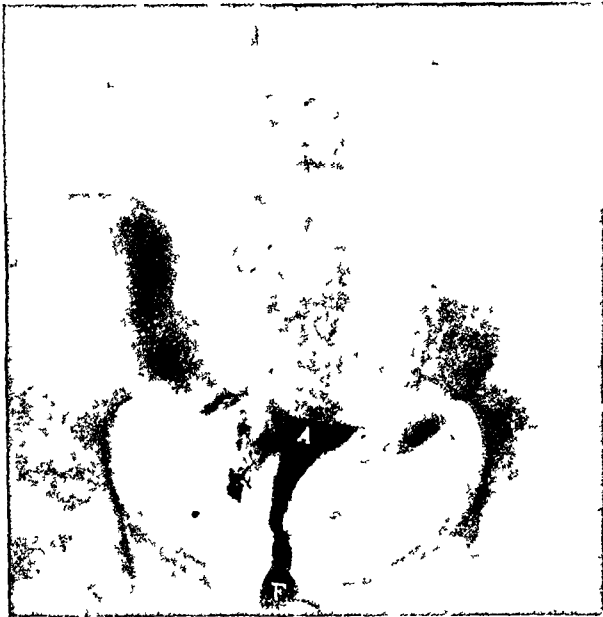


FIG. 6 Roentgenogram of pelvic viscera after insufflation of 1000 c.c. of gas, followed by 4 c.c. of iodized oil. It shows a large ovarian cyst anterior to uterus. Faint outline of fundus of uterus is shown posteriorly to that of cyst. Normal triangular shadow of uterine cavity is shown distinctly. Tubes are well outlined. Free oil is entering peritoneal cavity. (For explanation of letters cf. Fig. 2.)

ity to determine tubal patency, and iodized oil injection when the results of tubal insufflation were negative or uncertain and in conditions other than sterility where roentgenologic study was necessary.

Rubin<sup>8</sup> made comparative studies of his method in tubal insufflation and iodized oil injection in 66 cases. The findings with the two methods agreed in 60 cases, but there was some discrepancy in the other 6.

#### SOMETHING NEW IN IMPROVED APPARATUS

Of late, I have combined production of pneumoperitoneum with the injection of iodized oil and find the results most gratifying. I place the patient on a J. Bentley Squier table. The latter had to be somewhat modified in order to make it possible to put the patient in the Peterson posture, which I find indispensable for good results in this work.

In the Peterson partial knee-chest posture, the gas fills out the pelvis and enters all recesses around the pelvic viscera.

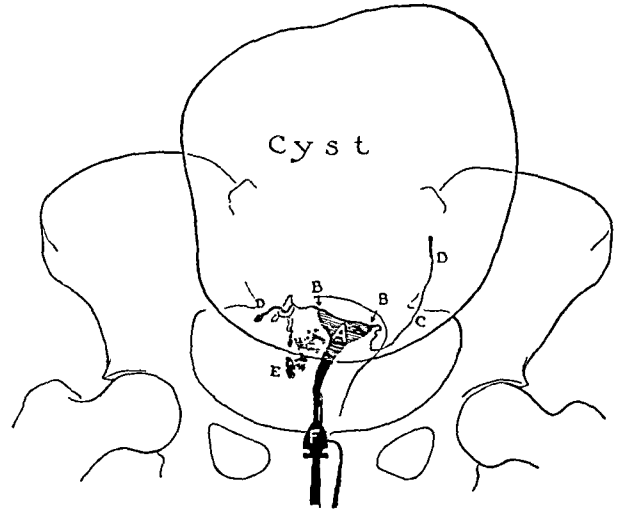


FIG. 7. Same as Figure 6 drawn to outline roentgenographic landmarks. (For explanation of letters cf. Fig. 2.)

The intestines gravitate out of the pelvis, facilitating greater clearness.

In my opinion, the apparatus I have designed (the pressometer) for the introduction of air or opaque media is especially well adapted for a combination of the two methods. To produce a pneumoperitoneum it is necessary to inject as much as 800 to 1500 c.c. of gas. It would be very undesirable to inject such large quantities of air into the abdominal cavity on account of its slow absorbability. I therefore attach a siphonmeter to the pressometer, through which the volume of gas can be measured, and introduce oxygen or carbon dioxide.

A "Y" connecting piece unites the oil reservoir, siphonmeter and nozzle leading to the uterus. The two short ends of the "Y" have stopcocks. When gas is introduced the stopcock leading to the siphonmeter is opened and gas enters the nozzle and uterus. When this is closed and the stopcock leading to the oil reservoir opened, the oil is allowed to run into the uterus. The oil is forced ahead by a rubber compressing bulb. The pressure of both gas and oil is recorded on the mercury manometer. The stopcock on the gas line has a side opening through which the gas

can be released, when the manometer registers too high pressure, as happens when the tubes are occluded.

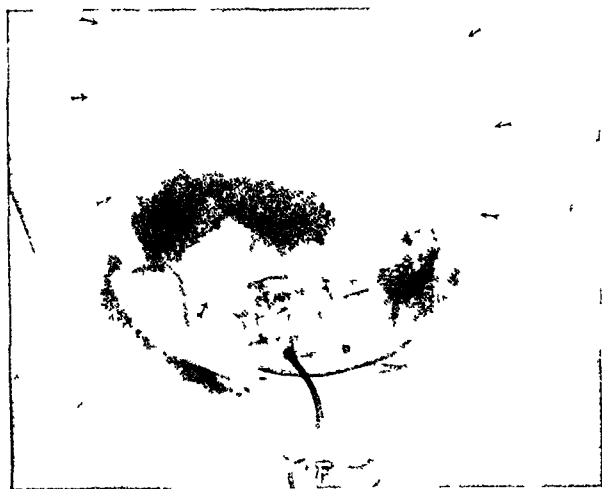


FIG. 8. Large right ovarian cyst outlined with arrows. Smaller cyst on left side was taken as a displaced uterus. Body of uterus was concealed by larger cyst. Roentgenogram showed exact pathologic condition. Oil was allowed to drain off uterine cavity before this plate was taken.

needle is plunged through the abdominal wall into the peritoneal cavity. The oil contrast medium is introduced through

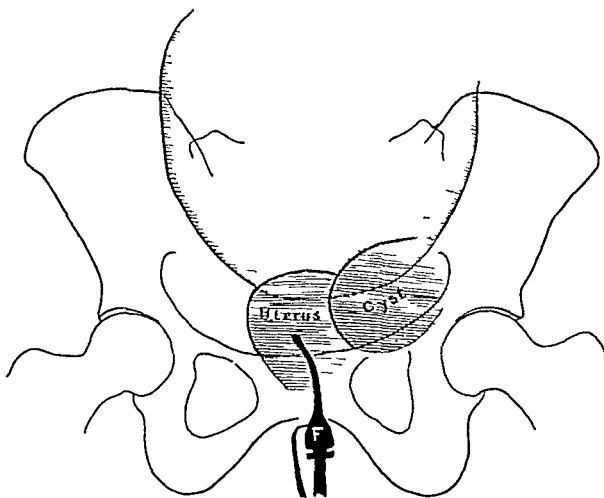


FIG. 9. Same as Figure 8. Drawn to illustrate relative size and relationship of cysts to uterus.

For preliminary transuterine pneumoperitoneum, connect adapter 1 to the manometer instead of adapter 2; turn arm of stopcock 4 at right angles to tubing to prevent the flow of oil from the reservoir into the nozzle.

Turn arm of stopcock 3 parallel to the tubing which leads to the siphonmeter. Then open the valve of the gas tank and gas will enter through the nozzle into the uterine cavity.

Stopcock indicated by "3" provides for the instant release of gas pressure by turning the arm parallel to the lateral outlet as illustrated.

To inject oil, detach adapter 1 from the manometer and attach adapter 2. Turn arm of stopcock 3 parallel to the lateral outlet as shown in Figure 1, and turn arm of stopcock 4 parallel to the tubing leading from the oil reservoir.

The instrument is then ready for the injection of iodized oil.

If the tubes are found to be occluded, a lumbar puncture needle is connected to the tubing leading from the siphonmeter, instead of the uterine nozzle, and the

the nozzle into the cervical canal, as before.

#### THE AUTHOR'S METHOD

It would be superfluous to give the details of the transuterine introduction of the media as they have been enumerated in the numerous works of Rubin<sup>4-9</sup> and also my own articles on uterosalpingography.<sup>24-26</sup>

In transabdominal insufflation, all advise that, if there is a scar in the abdominal wall, the needle should not be introduced through this scar lest a coil of intestine be adherent to it. I have done a perabdominal injection of gas in a woman who had had eight operations, five of them abdominal, without difficulty or untoward effect. Most observers state that no local anesthesia is necessary. I fully agree with them, although in some neurotic patients it is best to inject procain at the point of the introduction of the needle.

For beginners, I should advise the use of oxygen for the creation of the pneumoperitoneum rather than  $\text{CO}_2$ . The latter may be absorbed too rapidly and the beginner may be so slow in handling the patient as to lose the valuable information that a larger quantity of gas would give

him. Later, however, when one is sure of one's technique and can speed up the work,  $\text{CO}_2$  has greater advantage because its

an example. In this instance the combined method helped to exclude malignancy and saved the patient a ninth operation.

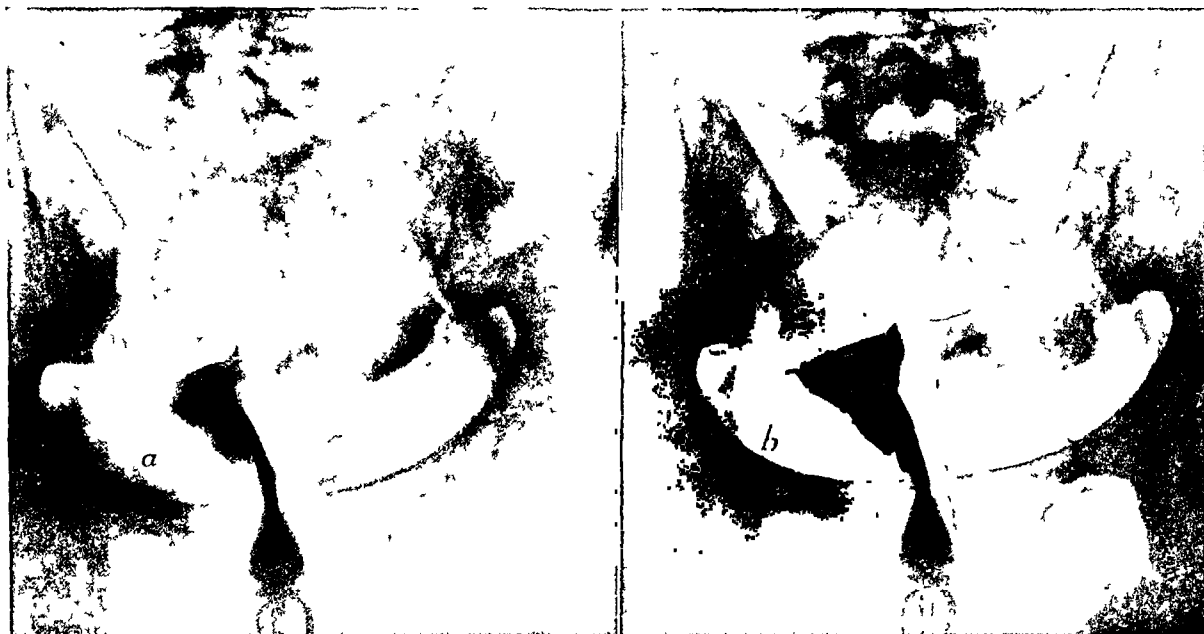


FIG. 10. Left ovarian cyst and right cystic ovary. Roentgenogram of pelvic viscera after insufflation of 1100 c.c. of gas. a. After injection of 4 c.c. of iodized oil, tubes are not filled. b. After injection of 6 c.c. of oil, tubes well outlined. This emphasizes the fact that sufficient contrast media must be injected; also, necessity of taking series of plates.

more rapid elimination contributes to the comfort of the patient.

I use the abdominal route for the introduction of gas when an attempt at its introduction through the uterus has proved

After 3 c.c. of the opaque oil medium are injected into the uterus, the first roentgenogram is made. More of the oil is then injected, and additional plates taken after 5, 8, 10 or even 15 c.c. The

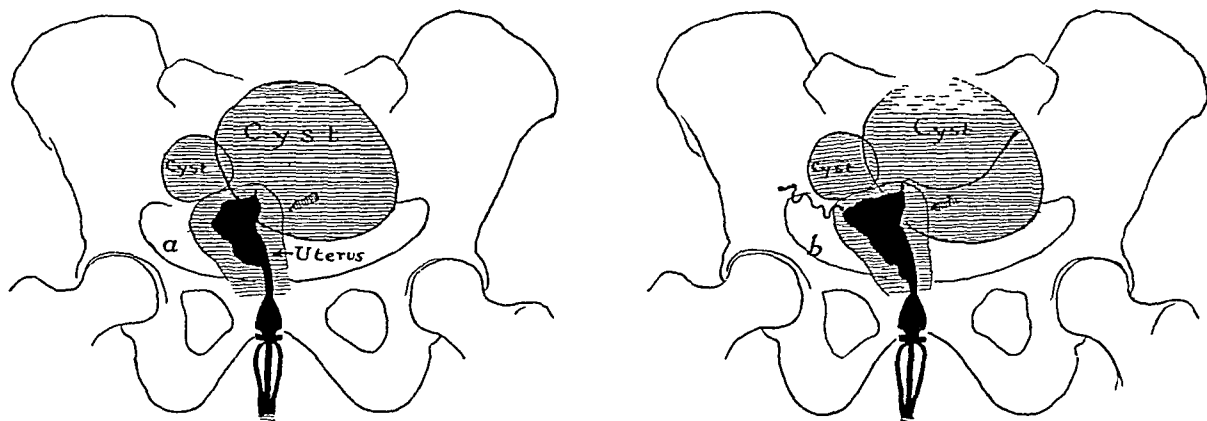


FIG. 11. Diagram to illustrate important points in Figure 10.

the occlusion of the tubes, when there is a bloody or purulent discharge, or where there is a suspicion of carcinoma of the corpus uteri. The case cited above of the woman who had had eight operations is

amount of oil to be injected and the number of films to be made depend entirely upon the experience of the physician in making a diagnosis and his desire for more complete records. At the beginning, he is

likely to expose more films than after he has acquired greater skill and experience in their interpretation. It is advisable to make one set of stereoscopic roentgenograms.

The combination of these two methods is indicated only when additional information, not obtainable by either method alone, is desired. When successful it enables the clinician to map out normal and abnormal states of the pelvic viscera. It outlines the inside and outside of the uterus. It often shows the tubes and normal ovaries. Neoplasms of the uterus and adnexa are often plainly visible. It also brings out distinctly the sphincters at the proximal end of the interstitial portion of the Fallopian tubes. This would lead one to call these sphincters uterine; or still better, in order to denote their exact location, cornual sphincters. That the sphincter is part of the uterine structure and is lined by uterine mucous membrane was shown by Römckes' anatomic investigations, as reported by S. N. Bakke<sup>27</sup> of Norway.

This method makes the diagnosis more precise. It often enables the surgeon to decide beforehand the best type of operation. It gives him a chance to explain to the patient what is likely to be done for her when operated upon. It enables the patient very often to choose the method of treatment, whether it is to be x-ray or surgery. This has happened in my experience on many occasions in treating women with fibroid tumors and sterility. These patients, when informed that the operation would not help them to become mothers as the uterus would have to be sacrificed, chose irradiation instead of operation for the relief of their condition.

I prefer to keep the patients in the hospital for twenty-four to forty-eight hours, especially those who receive more than 1000 c.c. of gas, as they are likely to have a great deal of shoulder pain and abdominal discomfort.

The roentgenograms, in most instances, are highly instructive, bringing out facts entirely unsuspected. On several occasions

I have found the patient to have bilateral ovarian cysts, while the pelvic examinations made by experienced men suggested only one cyst. This occurrence is shown in some of the accompanying roentgenograms. Such a disclosure was of great moment to me when I had told a patient that she had one cyst and assured her that she would retain her menstrual function and power of reproduction. I had to modify my statement after her roentgenogram disclosed neoplasms of both ovaries.

May I again remind the worker that the strictest asepsis should be maintained? Gentleness of technic will gain the coöperation and confidence of the patient, will facilitate the work and lead to good results and few complications. The physician does not require special skill or great training, only undivided attention to minute detail.

I have, in some cases, attempted to fill the bladder with gas after introducing iodized oil into the uterus but unfortunately did not obtain as gratifying information as did F. C. Steinharter and S. Brown.<sup>28</sup> Possibly, I did not give it sufficient trial.

I wish to express my gratitude and appreciation to Dr. A. S. Unger, director of the Department of Radiology in Sydenham Hospital, for his kind help and cooperation in doing this work. Also to Miss Florida Wyble, head technician of Sydenham Hospital, for her untiring assistance.

For the sake of brevity the histories of the patients are not given, as this article deals largely with the roentgenologic findings. Interpretation of the findings in most of these cases was corroborated by the subsequent operations.

#### CONCLUSIONS

1. The combined method of inducing pneumoperitoneum by insufflation and of uterosalpingography yields valuable diagnostic information in gynecology.
2. The author has introduced a new apparatus (the pressometer), which is

well adapted to the combination of these two methods.

3. In the hands of beginners, oxygen is best used for insufflation, because it is more slowly absorbed and allows ample time for roentgenography. In skilled hands, however, the use of carbon dioxide contributes to the comfort of the patient.

4. Use of the combined methods enables

the clinician to map out normal and abnormal states of the pelvic viscera, outlines the inside and outside of the uterus, brings out the sphincters sharply, shows the fallopian tubes and ovaries, and often makes neoplasms of the uterus and adnexa plainly visible.

5. The procedure should be performed in the hospital under conditions of strict surgical asepsis.

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# THE ROENTGENOLOGICAL ASPECTS OF EMPYEMA\*

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ROENTGENOLOGIC study is of value in empyema in two ways. The roentgenologist's cooperation is required in dealing with suspected cases, for the diagnosis of the presence, amount and position of fluid in the pleural cavity. His assistance, however, is also required in established cases, to observe the progress of the disease, to determine the effects of surgical procedures, and to elucidate factors preventing resolution. Fluid in the pleural cavity, except in minutest amount, can always be demonstrated by complete roentgenologic examination. The appearances produced are, for the most part, characteristic, especially when effusion is the only lesion. Some difficulty may occur in cases with double lesions, either primary lung disease with secondary empyema, or more rarely, primary empyema with secondary lung or pericardial involvement. X-ray study also permits accurate localization, whether the fluid lies superficially or deeply. This cannot be achieved with any degree of certainty by physical examination; in cases of deeply placed fluid it is impossible. Pleural effusions may exist either as free fluid, or may be loculated by adhesions, and may therefore be discussed under these two main headings.

The effusions associated with cardiac or renal disease, with rheumatic fever, with early malignant disease of the lungs and the uncomplicated effusions occurring in tuberculosis are all simple, non-purulent effusions or transudates, and do not properly come under the heading of empyemata. They produce, however, roentgenologic appearances almost identical with those produced by the free purulent effusions. These include a proportion of the acute pneumococcal exudates, and practically all the acute streptococcal, staphylococcal and influenzal exudates

in the earlier stages. From the point of view of treatment, it is of great importance to distinguish these free effusions, especially the streptococcal type, as it is necessary to wait for localization before instituting any form of radical drainage. Free purulent effusions also occur when the simple effusions of tuberculosis, or of malignant disease, become infected; or when the pleura becomes involved secondarily to chronic pyogenic disease of the lungs, such as abscess or bronchiectasis.

Pyogenic effusions have a natural tendency to limitation by adhesions. Such adhesions may exist from the beginning, especially in association with pneumonia, or may occur subsequently, as the disease develops. This causes the formation of localized collections of pus, so-called encapsulated, loculated or pocketed empyemata. These may occur in any portion of the pleural cavity as peripheral, mediastinal, diaphragmatic or interlobar pockets. Pleural effusions other than pyogenic, do not show this tendency to localization.

It is unnecessary to dwell at length on the purely mechanical details of the roentgenologic technique in the examination of these cases. A brief consideration of the general scheme of the examination of an empyema case is, however, advisable. The first roentgenologic examination in most clinics is usually the routine examination of the chest, taking a postero-anterior stereoscopic pair of films, with the patient sitting or standing. Tube distance should be at least four feet. With a patient who is very ill a "bed chest" roentgenogram, with the film under the patient's back and a short tube distance, will have to suffice although it is not of the same value. Such routine films will show the presence of fluid in any part of the chest, except retrocardiac, or low down

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in the posteroinferior sulcus, and will give an indication as to the line of approach for any further studies.

edge of the chest; that is, to establish definitely a relationship to the parietal pleura. The point on the chest wall to



FIG. 1. Axillary loculated empyema as shown in postero-anterior view, illustrating difficulty of diagnosis from one film only.



FIG. 2. As Fig. 1 but roentgenographed in the left anterior oblique position, showing fluid collection to lie posterolaterally.

Following this a fluoroscopic examination is essential. The patient has to be rotated and examined in all possible positions, sagittal, oblique, lateral, upright, prone, and supine. There are several principles involved,—one is to try to bring the surface of any suspected body of fluid into the line of the rays, as the diagnosis of fluid may depend on the determination of a definite edge. This is illustrated particularly well in Figures 1, and 2, which show an axillary loculated pocket as seen posteroanteriorly, and as seen in an oblique position. In the anterior film the ray is taken through the fluid, and the appearance is in no way characteristic; by rotation, however, the clear line of demarcation between the lesion and the lung is well brought out. The second principle is to determine the point at which the shadow suspected to be fluid, comes most prominently in contact with the apparent

which the rays are then tangent, is the point at which puncture can best be done (Point A in Fig. 2, for instance). Another point is to determine whether any marked change of contour occurs with the patient supine, or prone. If at all possible, the position of the fluid density, as seen in the lateral position, should also be determined, irrespective of which oblique position gives the most prominent views.

The same principles hold for the location of pockets in the interlobar fissures. The main fissure between the upper and lower lobes should be considered as a relatively flat surface, running obliquely downward and forward from the level of the second interspace behind, to the sixth rib in front. In the front view we therefore look obliquely through it. To observe the clear-cut edge of a fluid pocket in this fissure, one has the choice of two good positions. In the direct lateral view one is looking

along the fissure from side to side. Or again, by leaning the patient markedly backward and, if possible, tilting the tube

lesion against the film, is of great value. If the shadow caused by the fluid can be visualized even vaguely in a lateral film,

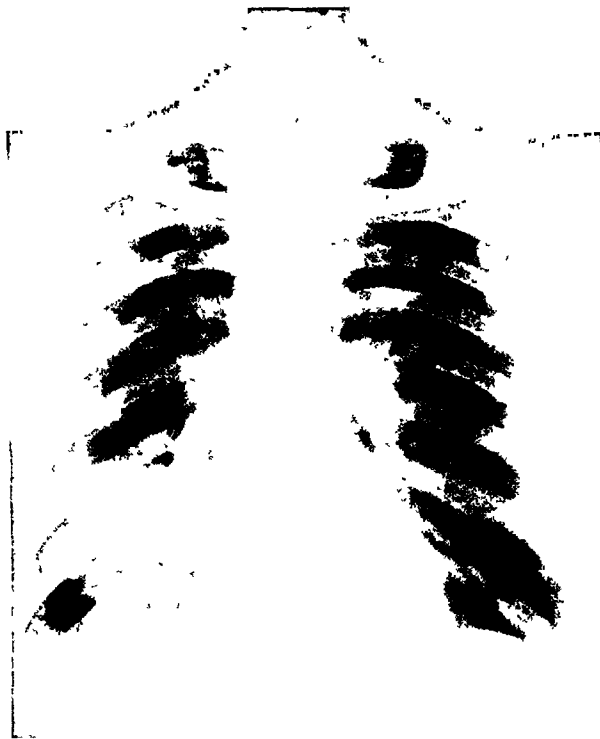


FIG. 3. Interlobar empyema between middle and lower lobes as seen in the posteroanterior view. Aspiration was done under fluoroscopic control and over 20 c.c. of pus was obtained.



FIG. 4. As Fig. 3 showing lateral view. Old lipiodol from previous per-tracheal lipiodolization is still present.

so that the incidence of the rays is from above and behind the neck down towards the xiphisternum, the fissure is visualized from end to end. In both of these ways a fluid edge can be beautifully demonstrated (Figs. 3, 4 and 5, show a pocket so visualized.) The upper surface of the middle lobe lies horizontally and is therefore quite suitably visualized in the posteroanterior position. Study in the lateral position moreover, shows any shadow from fluid in this fissure to lie anteriorly.

Having determined by such fluoroscopic examination the best positions in which to demonstrate the lesion, the patient is again radiographed. One or two additional films are taken in the positions found most diagnostic; this usually includes one oblique position, and one with the patient prone, or supine. In addition, a direct lateral roentgenogram, with the side of the

one can get quite accurate localization. In this way, by the combination of fluoroscopy and radiography, the expense of using multiple films in many positions is avoided.

The roentgenologic appearances produced by free effusions in the pleural cavity are well-known, and are characteristic. There is a gradual obliteration of the clear lung field by a homogeneous dense shadow, commencing with obliteration of the costophrenic angle (Fig. 6) and extending upwards. As seen in the posteroanterior view, the upper margin of the shadow curves from within, upwards and outwards, with a concavity upwards. In the absence of associated lung lesion, this upper edge may be relatively sharp, but as the fluid accumulates, the line of demarcation between fluid and lung becomes somewhat more hazy, owing to the zone of compressed atelectatic lung immediately overlying it (Fig. 7). Actually, the upper surface of the fluid presents a concavity upwards,

not only from within outwards, but also from front to back, the level being highest behind. There is then formed a bowl-

homogeneous; it completely obliterates the line of the diaphragm; and in an ordinary chest roentgenogram it almost conceals

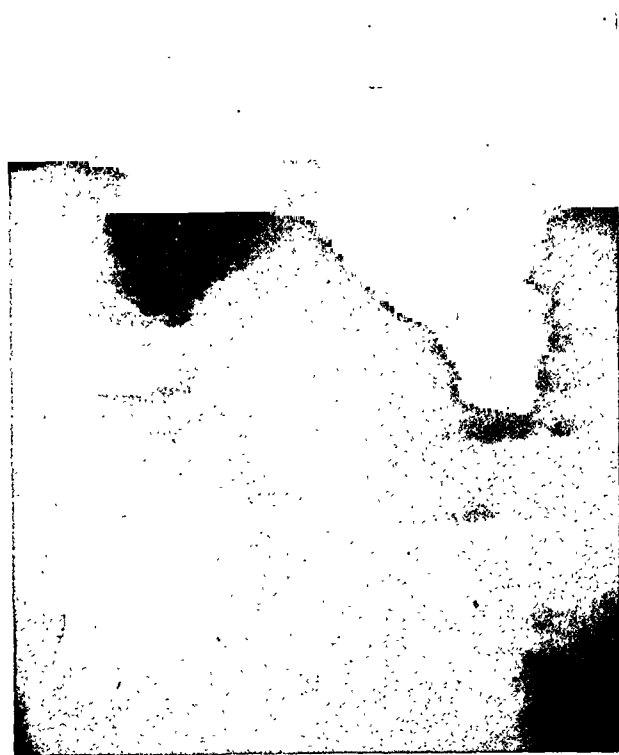


FIG. 5. As Fig. 3 showing the effect of roentgenographing from above and behind, along the plane of the main fissure.

shaped surface in which lies the compressed, partially atelectatic lower lobe.<sup>2</sup> This conformation is produced by the combined action of the forces of gravity, of the elastic recoil of the lung tissue, of capillary attraction, and of the limiting effect of the fixed hilus.<sup>3</sup> This curve is the characteristic sign of fluid, and is particularly true for the transudates, or the thin purulent fluids. A true primary purulent effusion, however, ordinarily commences as a thin surface layer of fibrinous, non-fluid exudate, which at first shows as a general "veiling" of the lung field and as a narrow double line along the axillary border of the lung field. This has been called lamellar pleurisy, and is especially common in children.<sup>3</sup> Later, this may remain a narrow continuation of the shadow of the fluid upwards into the axillary line<sup>1</sup> (Fig. 8). The shadow produced by fluid has three definite characters. The density is quite

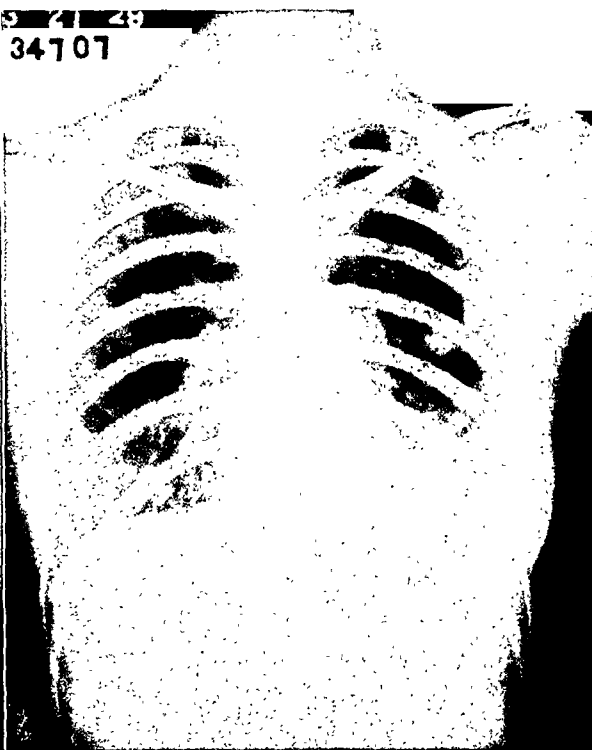


FIG. 6. Small pleural effusion (tuberculous etiology) occupying the costophrenic angle.

the rib shadows except at the lateral edge. As the fluid increases in amount, it gradually fills the pleural cavity till the whole lung field is blotted out. When any considerable quantity of fluid is present, especially on the left side,<sup>3</sup> the heart and mediastinum are pushed over to the opposite side, the ribs elevated and the interspaces widened (Fig. 9). Where the mediastinum has been fibrosed by previous inflammation, this displacement may not occur.

The effect on the distribution of fluid, of change of posture from standing to lying down, is important. With free fluid such as is found in transudates in the absence of a pneumothorax, the fluid moves slowly and almost imperceptibly into the apex, causing a general darkening of the whole lung field relatively to the other side.<sup>1</sup> With true pyogenic exudates, however, the surface of both the parietal and visceral pleura are coated with thin layers

of fibrinous exudate, which tend to fusion at the edges; for this reason very little alteration in fluid level takes place on lying

is always distinguishable by the deviation of the heart and mediastinum towards the side of the lesion, and by the relative rib

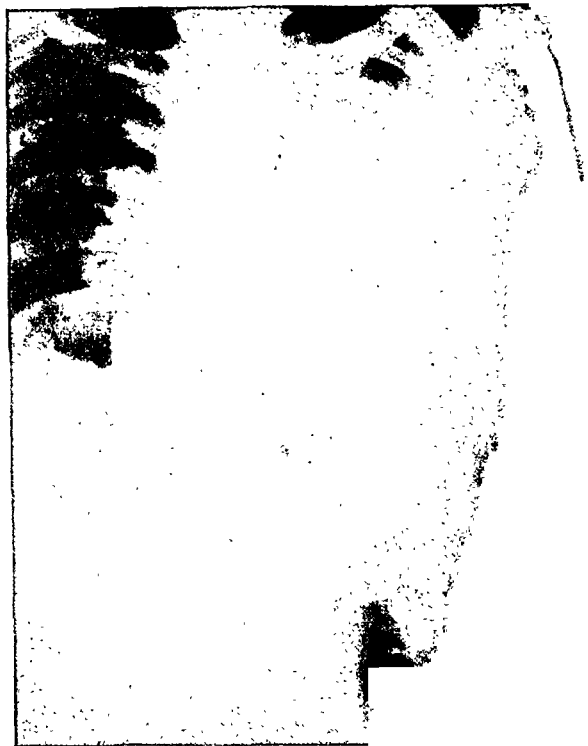


FIG. 7. Extensive free empyema of left pleural cavity following influenza. Over 250 c.c. of pus was aspirated and resolution obtained by closed drainage.



FIG. 8. Extensive free effusion (etiology unknown, but a streptococcal culture was obtained from fluid) with upward extension toward the apex.

down. There is some general increase in level, associated with the altered intrathoracic pressure from the abdominal viscera, but there is essentially no redistribution of the fluid even in the absence of true pocketing. (Stewart, of New York, quotes a case of a patient who was completely inverted without alteration of the fluid contours.)<sup>1</sup>

The shadow produced by fluid has to be differentiated from the shadow of the various consolidations of the lung or pleura. Of these, pneumonia occurs most frequently. The consolidation of pneumonia is, however, rather less marked; the line of the diaphragm can usually be made out; there is no characteristic curve; and it can often be shown, by fluoroscopic study, that the lesion lies within the lung tissue. The density in malignancy tends to be more circumscribed, and to lack a defined edge. The density produced by atelectasis

collapse on that side. Thickened pleura, resulting from an old lesion, often suggests fluid, but seldom persists over the whole pleural field and, if of long standing, causes contraction deformity of the thoracic cage of that side. A real difficulty, however, is met with when pneumonia or malignancy co-exist with fluid, and it may be impossible to differentiate the shadows produced by the fluid and by the consolidation respectively.

Loculated effusions may form in relationship to any portion of the surface of the pleura, superficial or deep. Various standard treatises<sup>1,2,3</sup>, on the subject classify and separately describe these pockets in relation to their different situations. They have, however, certain characteristics in common. The shadows produced by such collections are dense, homogeneous shadows with at least one definitely circumscribed edge which follows normal

anatomical pleural boundaries. As tension develops within these closed pockets, they have a tendency, moreover, where they

always at least one defined border which is related to pleura.

In their book on the roentgenology of



FIG. 9. Large pleural effusion filling the whole pleural cavity, associated with malignancy of the lung; 60 ounces of fluid were aspirated.



FIG. 10. Loculated empyema following pneumonia. Patient developed a bronchial fistula, but complete cure occurred following drainage through the chest wall.

impinge on yielding lung tissue, towards the formation of a smooth, circular boundary. Where formed in relation to the parietal pleura, some have their base upon the parietes, and bulge deeply into the elastic lung (Fig. 10). Multiple pockets may form, either as separate pockets or intercommunicating (Fig. 11). Some, however, produce an appearance very much resembling that of free fluid, and are produced by the walling off of a free effusion by adhesions; they are, as it were, a fixation of that process. Pleuromediastinal effusions show as localized widenings of the mediastinum sometimes parallel to the mediastinum, sometimes as a shadow with a border concave upwards and outwards, occupying the costophrenic angle.<sup>2</sup> Where formed in relation to a pneumonic process, as they often are, their shadows may be continuous with that of the consolidation. Even so, however, they have

the chest, Wessler and Jaches<sup>1</sup> give an excellent detailed classification of such loculated effusions. This may be summarized as follows,—

#### A. SUPERFICIAL EFFUSIONS OF PARIETAL ENCAPSULATED EFFUSIONS

- |                    |  |
|--------------------|--|
| 1. <i>Axillary</i> | Either anterior or posterior.  |
| 2. <i>Basal</i>    | Tends to resemble a free effusion and to lack the more usual contour of pocketed effusions.                              |
| 3. <i>Apical</i>   | Very apt to be mistaken for apical consolidations.<br>Has a strong tendency to extend, and become generalized.           |
| 4. <i>Mesial</i>   | Lie up against the pericardium anteriorly.<br>Apt to occur as a residual pocket after drainage of generalized effusions. |

#### B. CONCEALED EFFUSIONS—At no place related to the parietes.

- |                          |  |
|--------------------------|--|
| 1. <i>Intrapulmonary</i> | or "Diaphragmatic."                                |
|                          | The most difficult to diagnose roentgenologically. |

2. *Mediastinal*..... Lying between the lung and the heart, or mediastinum. Differential diagnosis from mediastinal conditions difficult, but important.
3. *Interlobar* ..... Sites,—
  - (a) in the oblique main fissure.
  - (b) in the horizontal right "middle" fissure.
 If progressive, tend to erupt to a bronchus, or to the general pleural cavity. Three clinical types exist,—
  - (a) Metapneumonic.
  - (b) Tuberculous.
  - (c) Idiopathic.
 Very difficult to discover or localize by physical examination alone.

#### C. MULTIPLE OR MULTILOCULAR EFFUSIONS

- Co-existence of several of the above.
- May be completely separate, or may communicate.
- Of clinical importance, as each requires to be individually drained.
- Separate pockets may contain different kinds of fluid.

Encapsulated effusions present a more difficult differential diagnostic problem than the free effusions, owing to their extreme variety. The diagnosis will often have to depend, ultimately, on exploratory aspiration of any suspected mass, after accurate localization roentgenologically. Lung abscess may produce somewhat similar appearances, but is intrapulmonary, has usually an irregular margin where it merges with the lung tissue, and may have a small air pocket. Plaques of dense pleural thickening arising as residues of old empyemata, are difficult to distinguish until they commence to show signs of calcification. They usually, however, lack the smoothly rounded contour of the actual fluid pocket. Benign, or relatively circumscribed malignant tumours of the pleura will practically always have to be differentiated by the absence of any causal history for an empyema. Most other lesions of the lung, tuberculosis, malignancy, syphilis, and the like, have their own identifying appearances, but here again, we have considerable difficulty where two

lesions co-exist. One minor point to note is to avoid confusing shadows of extrathoracic masses, as seen in posteroanterior films, for pleural densities.

Empyemata, if untreated, may absorb completely, leaving no trace. This occurs, though rarely, even with thick, purulent exudates, especially if there is a minimum amount of fibrinous plastic formation on the pleural surface. In the absence of spontaneous resolution, partial absorption may occur, and the remainder form a solid, dense, fibrous layer of thickened pleura, which ultimately calcifies. Such calcified plaques are common, and are exemplified by Figure 12. A rare example of complete pleural calcification is shown in Figure 13. With such a fibrosing or calcifying process, there occurs a bunching together of the ribs at the site of the lesion, and very frequently, a matting of the diaphragm across the costophrenic angle to the parietes, distorting and fixing the diaphragm; both of these are diagnostic points strongly suggestive of an old pleurisy.

Ordinarily, however, if empyema be left untreated, or if treatment prove ineffective, the disease goes on to the development of a chronic stage. The fluid may persist in closed pus pockets, and as such, act as foci of toxic absorption, and as a cause of vague ill-health. Much more often the cavity opens either into a bronchus, or on to the surface, or is opened, and persists for some reason or other. This results in a constantly or intermittently draining cavity with a persistent sinus.

In the examination of these cases, attention has to be given to the visualization of such cavities, and to the determination of their extent. This cannot be done by simple chest roentgenograms alone, as one has no method of determining the relative amounts of pleural thickening, and of fluid. It is necessary to inject the cavity with a contrast medium. There are three good media in use; lipiodol, or lipiodine, is certainly the most satisfactory medium. It can be diluted by equal quantities of olive oil or sesame oil; the

resultant 20 per cent solution affords ample density. Even so, however, in cavities of any size, this is an expensive method. A 20 per

the tube. The tube is then withdrawn, and the opening sealed over completely with collodion and absorbent cotton, be-

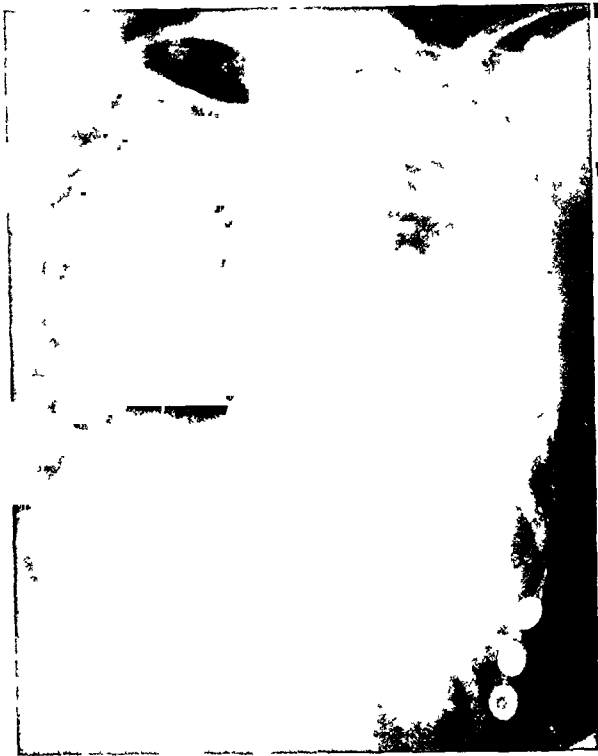


FIG. 11. Loculated empyema with multiple pockets. Separate drainage had to be established for each pocket.



FIG. 12. Calcified pleural plaque in right base. Three months history, many years ago, of a severe illness called "pleurisy."

cent solution of iodoform in sterilized sweet oil acts very satisfactorily, is easily made, and may possibly have a therapeutic value. Where neither of these is available, the ordinary water or water acacia emulsion of barium sulphate, as used for gastric fluoroscopy, is quite satisfactory, if sterilized. The various silver, or sodium iodide solutions and their like, may have some irritant action, and their use is not to be recommended.

Before filling, a cavity should be drained for a short time with the sinus in the most dependent position. The patient is then turned with the sinus upward, and with all necessary aseptic precautions, a fine rubber tube, attached to an ordinary 20 c.c. syringe, is passed as far as possible into the sinus. Any residual pus is aspirated, and then the cavity is filled slowly with contrast medium, until it overflows around

fore the patient is moved. As soon as the collodion has set, the patient can stand up, or even lie on the side of the lesion, without any escape of medium. The usual posteroanterior and lateral rays are then taken. In addition, however, a film should be exposed on the Potter-Bucky grid, with the patient in a position such that the sinus and the cavity are nearest to the film, using a lateral or oblique position as may be necessary. This not only gives a much clearer picture of the filled cavity, but also gives good visualization of the condition of the ribs at that point—an important point. Figures 14 and 15 represent two such visualized cavities, one posteriorly, and one laterally.

There are many causes for the persistence of a cavity. Of these, the most common is a thickened pleura rendering the walls rigid, and preventing expansion



of the lung (Fig. 16). A frequent concomitant of this, or existing by itself, is the presence of drainage established at some

shown by lipiodolization of the lungs, via the trachea, in the ordinary way. It should also be kept in mind that the condition

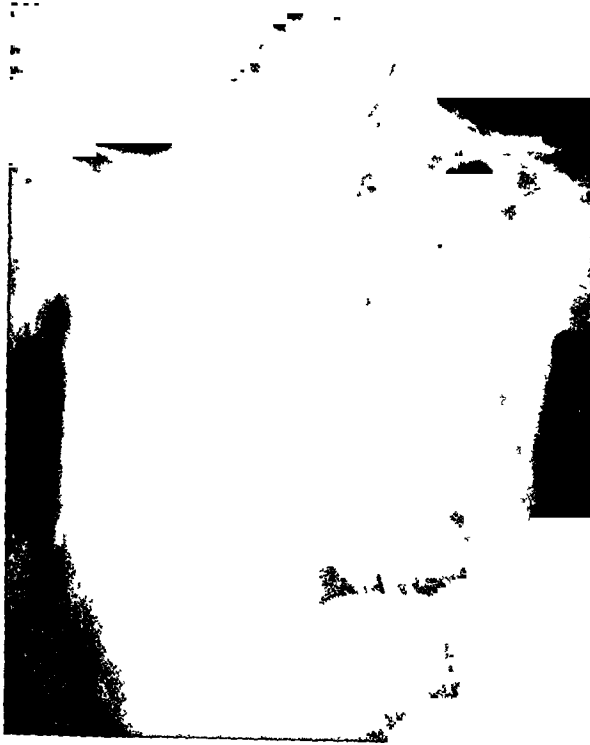


FIG. 13. Complete calcified cast of pleural cavity. Patient had a large empyema fourteen years ago. She was now sixty-four years of age, and had no symptoms whatever.



FIG. 14. Persistent empyema cavity injected with lipiodol. Condition postpneumonic, and persistence due to thickened pleura. Thoracoplasty, with decortication, resulted in cure.

point other than the lowest point of the cavity. Another possibility is the persistence of separate, unopened, unsuspected cavities. Sometimes one finds a foreign body, or a chip of bone at the bottom of the sinus. This is especially likely where there is a long narrow sinus, with no other apparent reason for failure to close (Fig. 15). These various conditions of the cavity may all be demonstrated by contrast filling, as described. Even in the absence of thickened pleura to bind it down, the lung may develop an intrinsic fibrosis which prevents its expansion. Communication between the cavity and a bronchus, either through an erupted abscess or through primary rupture of a loculated empyema, may complicate the process. Sometimes this can be demonstrated by injection of the cavity with lipiodol; at other times, the communication is best

of the ribs, or infection of the ribs at the old site of a resection, may be the cause of trouble.

The addition of a pneumothorax, partial or total, to any empyema process, is a common thing. This may occur in closed empyemata, after aspirating. Most commonly, however, in chronic pleural pockets, one finds air in conjunction with fluid, as partial pyopneumothorax. The presence of such air is of value roentgenologically in outlining the extent of any cavity, and in showing the degree of pleural thickening walling it. A characteristic feature of any such pocket is the so-called "fluid level." The upper surface of the fluid moves freely within the cavity and maintains itself horizontally, whatever the position of the patient. By examining the patient in several positions, the whole extent of the wall of the cavity can be accurately de-

terminated, and communication between multiple pockets identified. It is also worth noting that in certain cases of free

has done the same thing without roentgenologic assistance. By a correlation of these two groups of findings with each other,



FIG. 15. Persistent empyema sinus injected with lipiodol. Persistence was due to chip of bone in depth of the sinus.



FIG. 16. Old empyema cavity with perfect drainage, but rigid and thickened walls. Condition postpneumonic, and of thirteen years standing.

effusion, a replacement of whole or part of the fluid by air, may render visible any associated parenchymal lesions not otherwise demonstrable.

These, then, are the more common conditions found associated with infection of the pleural cavity. It is probably wiser for the roentgenologist to make as complete an examination as possible, before he takes any cognizance of the clinical facts. He can then make up his mind in an unbiased manner as to what he thinks the conditions are. Only thereafter should he consult with the clinician, who, meantime,

and with the history, it is usually possible to achieve a very accurate idea of what the real state of affairs is in the thoracic cavity.

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# THREE CASES OF NEUROMA:

## CIRSOID NEUROMA OF FACE; NEUROFIBROMA OF STOMACH; POSTERIOR TIBIAL NEUROFIBROMA\*

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**A**MONG the rareties of radiological practice are positive findings in cases of tumor of peripheral nerves. A description of three rare nerve tumors with positive radiological findings should therefore prove of great interest and importance, and, by stimulating more frequent recourse to x-ray study in neurological cases, should assist in increasing the frequency with which such tumors are recognized in advance of operation.

### CASE I. EXTENSIVE CIRSOID NEUROMA OF FACE

Figure 1 shows the appearance of the facial tumor of H. D. K., a young man of twenty-six, on June 1, 1915 when he applied to me for examination of a swelling on the right side of the face. The patient stated that he was born with this deformity of the face. At the time of examination the right cheek was large, and the right eye so badly swollen that he could hardly see. All the tissues of the right side of the face were very much infiltrated and thickened. There was also a similar smaller tumor in the right supraorbital region. None of the swellings were painful. At the age of twelve, after having been thrown from a horse, striking on the head, the patient was unconscious for twelve hours. During the last eight or nine years, there had occurred a progressive enlargement of the growth. Seven years before the present examination two operations had been done without apparent success.

Roentgen examination of the skull in the anteroposterior direction failed to reveal asymmetry of the malar bones. Both right maxillae, however, were deformed by the pressure of the tumor, and the molars were distorted so that they pointed directly inward. The bicuspids were deflected to a lesser degree.

The lateral stereoroentgenogram of the head showed several well defined localized areas of decreased opacity of the cranial bones on the right side of the skull. One of these conspicuously thinned areas was located in the parietal

bone, two in the frontal bone, and one was apparently divided between the parietal and the temporal bones, the thinned out area apparently not in any way respecting the suture line. There was a distinct clouding of the right maxillary sinus, also a deformity of the upper and the lower maxillae on the right side, which were pushed inward by the mass of the tumor. The thinning of the bone is well shown in the roentgenogram (Fig. 2).

Careful neurological examination by Doctor W. H. Riley failed to reveal any neurological findings which were attributable to the tumor, aside from the defective vision. Examination of the eye grounds showed 20/60 vision in the right eye, 20/40 vision in the left eye. All the intraocular blood vessels showed a hyperemia, this being noted especially in the nerve heads. There was no particular difference between the two sides.

In considering the plan of treatment, it was decided to avoid hot water injections, at least until a histological diagnosis could be established, and to attempt the reduction of the tumor (1) by surgical removal of the large tumor beneath the right malar bone and the smaller tumor above the right eye, and (2) by treating the remnants of the tumor and the remainder of the involved areas of skin by roentgen-ray therapy, using what were then considered the harder rays and heavy doses, through a filter of 4 mm. of aluminum with an added 3 mm. of sole leather.

On June 3, 1915, we removed from above the right eyebrow what appeared to be a vascular tumor the size of a walnut. The tumor was adherent, on its under surface, to the periosteum of the supraorbital arch. The upper surface of the tumor seemed to be intimately associated with the skin in such a way as to make it difficult to find the line of division between tumor and skin. At the same operation there was removed from beneath the right malar bone an irregular globular mass 7 cm. in diameter, intimately adherent to the periosteum of the upper alveolar arch and to the anterior surface of the superior maxilla.

\*Submitted for Publication February 27, 1930.

After three weeks, a further reduction of the tumor was attempted by means of the roentgen rays. The skin overlying the affected area was

neurofibroma or plexiform neuroma has been given, is practically always congenital. The upper eyelid, the cheeks, the region of the



FIG. 1. Preoperative appearance of Case 1. Cirroid neuroma.



FIG. 2. Extensive thinning of the cranial bones of Case 1.

so divided as to afford six portals of entry. Not only the face, but the areas of the skull which were shown by the roentgenograms to have been thinned, were subjected to roentgenotherapy. At first it was thought that a diminution of the facial swelling could be appreciated; but after some months of routine intensive therapy with the hardest rays then obtainable and with the filter above mentioned, this form of therapy was abandoned.

On November we returned the patient to the operating room for removal of as much as possible of the remaining tumor tissue. No recurrence having been observed since the last operation, we felt encouraged to do as radical a removal as possible, especially in view of the pathological report from Dr. A. S. Warthin. The result was fairly satisfactory from a cosmetic standpoint (Fig. 3); at any rate the patient expressed himself as well pleased.

The microscopic examination of the tissue by Dr. Warthin resulted in a report of a vascular fibrous tumor containing chiefly non-medullated nerve fibers, with muscle fibers in and between nerve bundles (Figs. 3, 4).

This form of tumor, to which the name cirroid

ear, the back and the breast are the principal sites of this type of neuroma, which often causes curious deformities, as in the nape of the neck, the face, the extremities and the external genitals. Bruns was first to apply the term cirroid to this type of nerve tumor, composed of plexuses of convoluted strands or cords held together by a soft, loose, fatty connective tissue. Although it may be found as a more or less circumscribed tumor-like mass, it may present, as in this case, no capsular or other limitation, perforating the neighboring fasciae, penetrating the muscles in all directions, adhering to the periosteum, and lodging in grooves or foramina in bone, as the flat bones of the skull or the roof of the orbit. It may be very intimately connected with the overlying skin which may be much thickened (Alexis Thompson). All the foregoing characteristics were presented in the case herewith reported. Of a series of 58 cases reported by Thompson, 18 occurred in the temple, forehead and upper eyelid; 14 in the posterior part of the neck and behind the auricle, 4 on the nose and cheek, 5 in the lower jaw and anterior half of the neck, 8 in the breast and back, and 9 in the extremities.

In spite of the apparent futility of the radiation therapy in this case, as judged by

the result in 1915, the afterhistory of the case and the clinical results in other cases of fibromatous tissue under roentgenotherapy,

near the pylorus, having the appearance similar to that noted in some cases of large gallbladder compressing the wall of the



FIG. 3. Microphotographic appearance of cirroid neuroma of Case 1, showing nerve trunks and muscle fibers in the mass of nerves (low power).

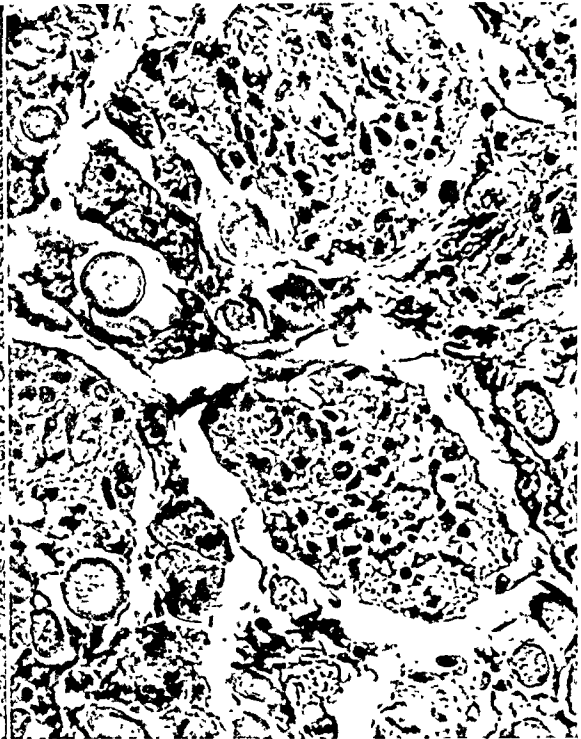


FIG. 4. High power view of histological structure of cirroid neuroma, Case 1, showing muscle fibers in and between nerve bundles.

lead us to suspect that after all it may have been the roentgenotherapy which has been chiefly responsible for the failure of the tumor to recur. The patient was alive and well according to a letter received in the fall of 1929, although he has not presented himself for a photograph of his present appearance. No further treatment with x-rays has been administered in the intervening fifteen years. Fig. 5 shows the final result in December 1915.

#### CASE II. GASTRIC NEUROFIBROMA

Mrs. M. L., age 47, presented herself in May 1926 for relief of indigestion and epigastric pain. The clinical symptoms led to a radiological examination of the gallbladder by Graham's intravenous method which resulted in a diagnosis of multiple non-opaque gallstones, practically filling the gallbladder. The gallbladder appeared to be of unusually large size (Fig. 6, a). A gastrointestinal x-ray study was also carried out without any report of a pathological finding. A small, shallow filling-defect, was seen on the greater curvature



FIG. 5. Appearance of Case 1, at close of surgical and x-ray treatment in 1915. No essential change to the present date.

stomach; and in this case it was thought to be due to the pressure of the large gallbladder

(Fig. 6, b, c, d). The filling-defect seemed to be more or less ovoid and with borders that gradually faded into the density of the gastric

from the posterior wall of the stomach and the wound closed in the transverse diameter. At the time of operation the mass was thought

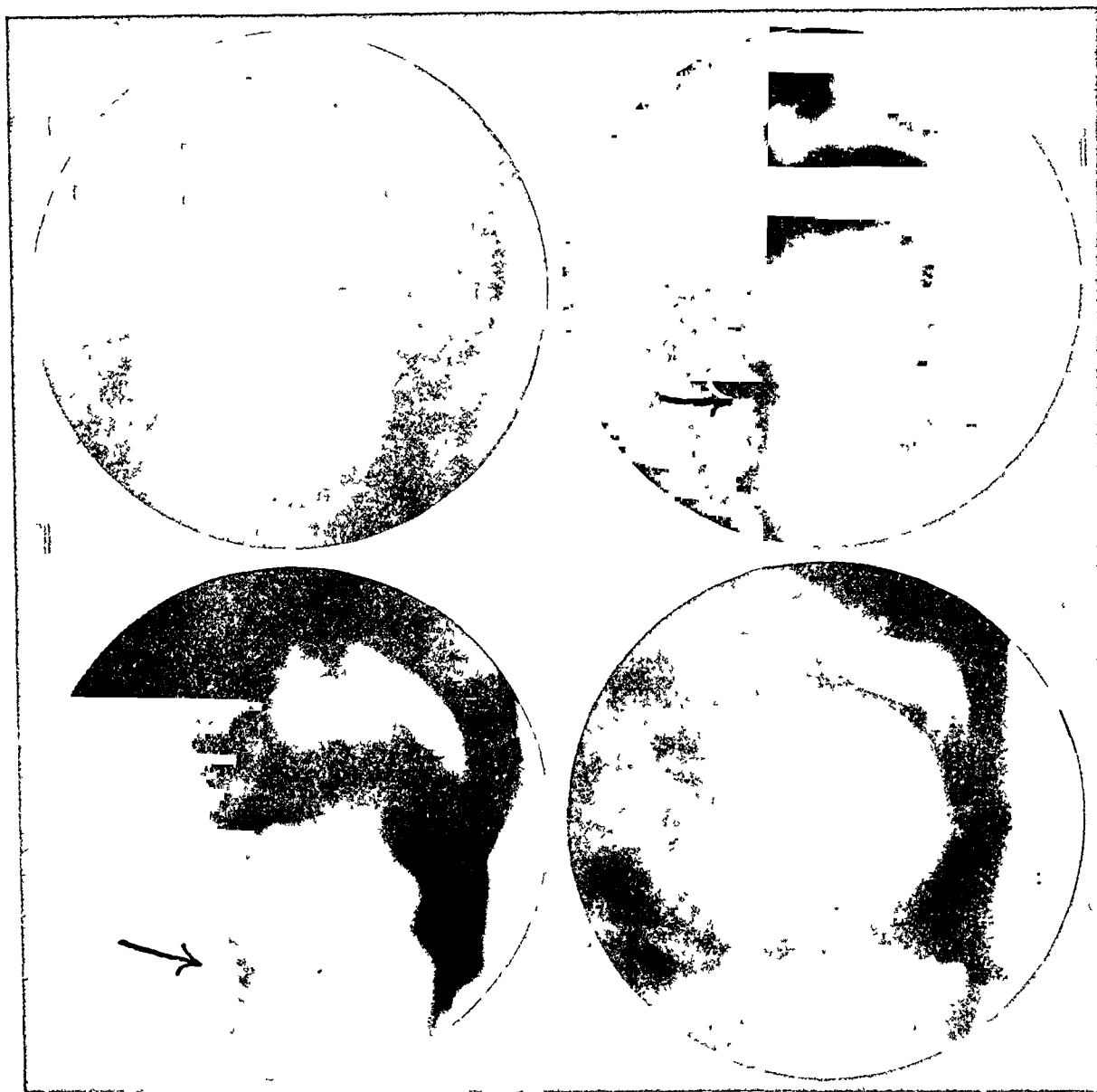


FIG. 6. Case 11. (a) Cholecystogram showing multiple non-opaque gallstones. (b) and (c) Faint filling-defect in greater curvature of stomach shadow, really due to gastric neuroma on posterior wall, but erroneously interpreted before operation as being associated with pressure from the stone-filled gall-bladder. (d) Another film from the same series showing a high grade of spasm in the stomach at the site of the neuroma.

shadow, thus suggesting an extrinsic rather than an intrinsic cause.

At operation by Dr. W. E. Shackleton, of Kalamazoo, Mich., on May 11, 1926, a moderately distended gallbladder filled with stones was removed, and on examination of the stomach there was found on the posterior wall a tumor mass near the pylorus, 6 cm. in diameter, without any palpable glands in the neighborhood. The tumor mass was resected

to be malignant but Dr. Warthin's report on the histology of the tumor was that of a neurofibroma, primarily a disturbance of development (Fig. 7).

G. Lardennois<sup>1</sup> in 1928 reported a gastric neuroma removed by gastrotomy but which before operation was reported by Henri Bécclère as a benign tumor on the basis of the roentgenographic findings. A woman of 58 gave a history of a gastric hemorrhage, followed

by melena of definite grade. The patient then recalled that on previous occasions she had noted dark blood in the stools. She had never

to 1927 Balfour and Henderson<sup>2</sup> were able to report 38 cases of benign gastric tumors.

Our failure to recognize the definitely gastric

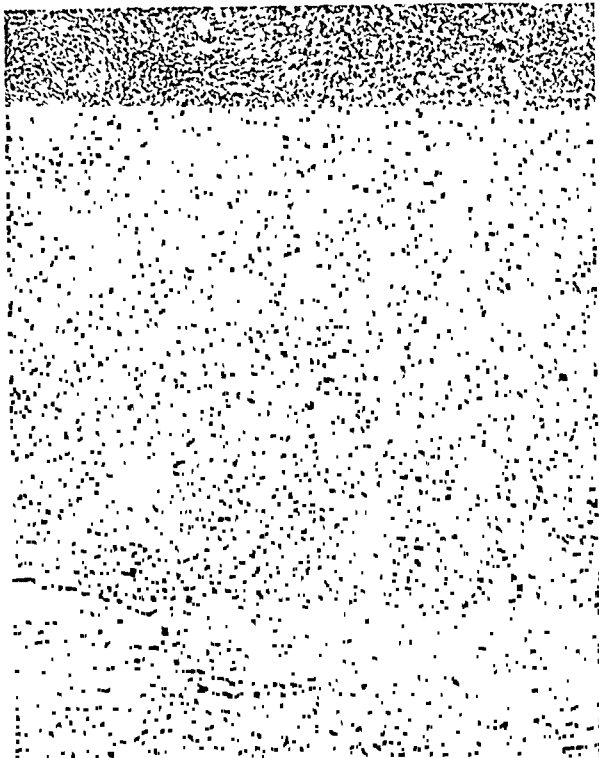


FIG. 7. Microphotographic appearance of the gastric neuroma of Case II.

vomited and there had been no gastric disturbance of a painful nature. Following the definite hemorrhage with black stools, there continued to be a leakage of blood at the site of the tumor as shown by constantly positive occult blood findings in the excreta. On a tentative diagnosis of duodenal ulcer, B  cl  re made a radiological study resulting in the finding of a clear zone, giving the impression under fluoroscopic manipulation of a polypoid growth implanted in the gastric wall. A re-examination confirmed the opinion that one dealt with a benign tumor. Operation confirmed the opinion. The author removed from the anterior wall of the stomach in its middle third a tumor the size of an apricot which on histological examination proved to be a peripheral glioma, included within the thickness of the muscular wall. The bleeding had its origin in a mucosal ulcerated area in the most exposed part of the prominence of the gastric wall caused by the tumor.

Statistics from the Mayo clinic indicate that there occur one benign tumor of the stomach to about eighty malignant growths. From 1922

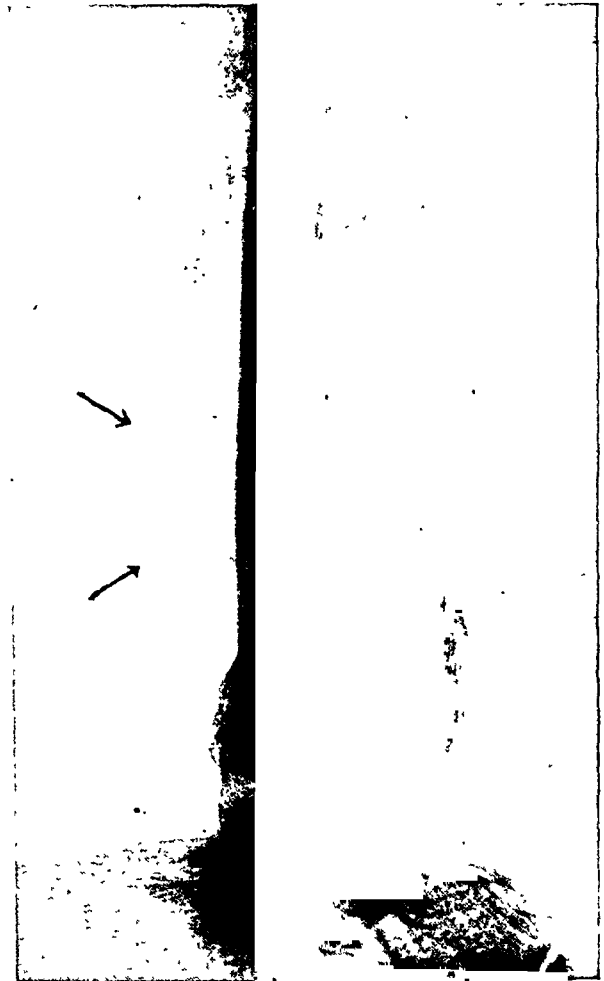


FIG. 8. Roentgenogram of left leg, showing normal bony structure, and a soft tissue tumor (at arrows) between the bones and the Achilles tendon, proved to be a neurofibroma of the posterior tibial nerve. The tumor caused definite local displacement of the calcified posterior tibial artery.

origin of the tumor in our Case II, illustrates how important it is to commence every radioscopic study of the stomach by careful palpation under the screen at once after the first swallow of the opaque meal, for when the full meal has been ingested it is much more difficult to recognize a tumor, especially when located on the posterior wall.

### CASE III. NEUROFIBROMA OF THE POSTERIOR TIBIAL NERVE

This case, though previously included in a report<sup>3</sup> on false peripheral neuromata, is referred to here because of the interesting radiological finding. Mr. A. P., age 63, came to me in August,

1927, for treatment of a neuritis involving the left leg and foot. There was found a rounded swelling about 2 cm. in diameter, on the left leg just above the ankle, most evident on the internal aspect of the member. The tumor was movable laterally to a limited degree, but not at all in the long axis of the leg. It was not attached to the skin, and was not sensitive to gentle pressure. Pinching or hard pressure caused intense pain to shoot into the foot. The lump was first noticed about twenty years before admission, and was much smaller then than at the time of examination, having undergone gradual though slow growth. Roentgen-ray study (Fig. 8) did not reveal any abnormality of the bones of the leg or ankle, but it did show distinctly the presence of a soft tissue tumor between the shadow cast by the Achilles tendon and the bones of the leg, causing a local displacement of the neighboring calcareous posterior tibial artery, the soft tissue shadow corresponding accurately to the palpable painful tumor. The findings led to a diagnosis of neuroma of the posterior tibial nerve.

Under local anesthesia the posterior tibial nerve was exposed through a longitudinal incision on the inner side of the left leg just above the ankle. The nerve was found to surround a well-encapsulated, fusiform tumor about 3 cm. in diameter. The sheath of the nerve was split longitudinally and the tumor enucleated with very little traumatism to the nerve tissues.

The pathologist's report on the tumor indicated a pure neuroma in some areas, neuroglia in others. No ganglia cells were found, although there were atypical neuroblasts. The nerve fibers were chiefly non-medullated. Throughout the tumor there were large and atypical lymphatics and blood vessels. Some bloodvessels showed some hyaline change in the walls, a cylindromatous change. There were also areas of myxomatous tissue scattered throughout the growth and some pigmented areas from old hemorrhage. The general structure was that of a congenital disturbance of development resembling the cirroid neuroangioma (Warthin).

#### SUMMARY

Three cases of nerve tumor, of the

neurofibroma variety, two of them having characteristics resembling cirroid growths, are reported to illustrate the value of the roentgenological study in a field where x-ray aid is not ordinarily sought.

In an extensive cirroid neurofibroma of the head and face, the roentgen study revealed extraordinary thinning of the cranial bones and distortion of the upper and lower jaw and the teeth of the affected side of the face. The long duration of apparent freedom from recurrence following combined surgical and roentgenotherapeutic attack fifteen years ago, in spite of recurrence and continued growth following previous treatment by surgery alone, suggests that it is worth while treating such neuromas by x-ray or radium alone or as a supplement to surgical intervention according to the case.

A fairly large neurofibroma of the posterior wall of the stomach near the pylorus was missed in the pre-operative x-ray study because of the spectacular finding of a large gallbladder filled with stones and the assumption that this large gallbladder was the cause of the filling-defect in the greater curvature aspect of the stomach near the pylorus in reality due to the neuroma.

A neurofibroma of the posterior tibial nerve was well demonstrated in the roentgenogram by its faint but well-defined shadow in the soft tissues of the leg, and especially by its displacement of the posterior tibial artery rendered visible by an unusual grade of calcareous degeneration.

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# NOTES ON THE ETIOLOGY OF CANCER\*

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NEVER before in the world's history has the subject of cancer been under closer scrutiny than at the present time, for practically every educational group of higher intelligence the world over is making a sweeping investigation of all the available data which may have bearing upon the whole cancer problem. The writer, therefore, takes the liberty of submitting a few notes on this subject, some of which are purely empiric, but are gleaned nevertheless from a personal clinical experience with cancer over a twenty-five year period, and upon a fairly large representative cancer group.

What influence has mechanical irritation upon the production of cancer? In the writer's opinion, the importance of this has been greatly overestimated, even to the point of assumption that its part in the production of a latent cancer may be considered negligible. With chemical irritation we believe that we can also take a similar though somewhat modified view. This whole subject is still so insecure that one hesitates to inject personal opinion, yet withal is so important that this phase cannot well be omitted from any article dealing with the theory of cancer causation.

Our partner, Dr. O. N. Meland, offers the following discussion on the effect of chemicals:

"What effect chemicals have in the production of cancer is a difficult question to answer offhand. Certain it is that only a very few individuals who are exposed to chemical irritants develop malignant disease. Observation of those who are engaged in industries where the skin is subject to the products they are preparing, shows that the products of coal tar distillation seem to be one of the offending elements.

"Thus, we have the paraffin cancers in the paraffin workers, the chimney sweep's

cancer due to scrotal irritation from soot, and of workers engaged in these pursuits, only a small fraction develop malignant skin lesions, and those come after a long period of exposure.

"Experiments on mice and rats reveal that a small number will develop skin cancer after prolonged painting with tar, but rabbits and guinea pigs, when subjected to the same chemicals, practically never develop anything suggestive of a surface cancer. This leads us to believe that whatever rôle the chemical plays, it must be a minor one, or rather it is merely an exciting agent. In other words, the soil must be prepared before irritation will bear fruit.

"What the underlying factor is, no one knows, but it probably is hereditary in nature, as Doctor Maud Slye has demonstrated in her work of twenty years with mice. Whether the irritant factor is to be followed by cancer will depend upon what the cell has hidden within itself. If a susceptibility exists and has been handed down through the germ plasm, then a long continued irritation by any one of a variety of chemical or physical stimuli may be followed by cancer in these unfortunate individuals."

Combined mechanical and chemical irritations will without question so damage cell structures at the point of contact that any infection may well prosper there, but what have these factors to do with the residual, hereditary, or sleeping cancer cell without which, in the writer's opinion, no cancer growth could prosper? If this view should prevail, then our time spent in seeking a specific germ, or by the same reasoning a curative or preventive serum from such, is wasted. This does not mean that carcinoma is considered to be in the nature of an infection, but that infection

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plays a very important rôle in the incidence of cancer. It is therefore obvious that its removal together with its cause, materially improves the patient's condition and renders much more probable the successful destruction of the cancerous process itself.

Can one draw any conclusions as to the cause of cancer from a study of the tissues in the regions where cancer most frequently originates? Let us briefly consider this question in the ratio of its selectivity: in man, the face, lip, tongue and stomach; in woman, the breast and the uterus.

In the skin, the face is the location of choice for epithelioma. Here irritation of all sorts, it must be admitted, is more probable than on the covered and protected parts. Even the hands are less exposed, as they are frequently in a man's pocket or in a woman's glove. Therefore, the face is always in the weather and meets all external attacks from the front. Hence, prominent features of the face are usually the seat of local abrasions, irritations, infections, and then epithelioma.

How much do the irritating factors in this illustration contribute to the development of epithelioma? If the writer's opening statement be accepted, that irritating factors play only a minor part in the role of cancer production, how can one reconcile this to the apparent fact that cancer of the skin occurs most frequently upon the face, and the face is almost continually subjected to the irritating factors enumerated?

Conversely, we know that approximately ten percent of the human race acquires cancer. However, this ten percent includes cancer distributed in all parts of the body. Hence, we must rightfully assume that much less than ten percent of all cancer, and even less than five percent, actually originates in the skin of the face.

If, therefore, irritation is considered an important agent in cancer production, why does not the other ninety-five or more percent of the human race, whose skin is equally exposed to irritation, devel-

op cancer? It is this large discrepancy in figures which cannot be lightly laid aside when one is attempting to analyze the brief available facts already accumulated concerning cancer.

The daily shave of men is certainly a decidedly irritating factor where the skin is constantly bruised and frequently injured. Yet, we have no evidence to show that the ratio of epithelioma is greater among the shaved than the unshaved. Similar irregularities to which the tongue is subjected may have a strong bearing upon the incidence of cancer in this organ; yet here we have the added irritation with food products of extreme temperatures and of a kind and degree never intended by nature as fit for human consumption. Surely the external skin is never subjected to such unnatural stimulation, and if this were a predominating influence in the production of cancer, nearly every male individual, and not a few females, would develop epithelioma of the lip, tongue, or mouth.

The lower lip in man is predominant in primary cancer, which ordinarily begins at the junction point of skin and mucous membrane; possibly this may be a locus minoris resistentia or a weak spot in the fusion line of the respective epithelial cells. Here we have present not only the external irritation alluded to, but also such injury as may arise from careless mouth hygiene, use of tobacco, carious teeth, and other insults.

We may as well here include the stomach. This organ chooses the region of the pylorus as its objective for carcinoma. At this point the mucous membrane of the stomach fuses with mucous membrane of the duodenum; still cancer does not select this fusion point as its most frequent habitat but seems to invade more frequently the lesser curvature proximal to the sphincter. In the stomach, however, we have two distinct but powerful irritating factors—the muscular or mechanical, and the secretory or chemical. These, together with abnormal food contacts, make a formidable array of irritants which

would soon decimate the human world which we now term civilized, if they alone were the causative agents of cancer.

As has already been pointed out, cancer of the skin in early womanhood is relatively rare, much more so than in early manhood. In woman it is difficult to say which organ exercises the predominating influence the breast or the uterus. From the literature, one would adduce that the two run almost parallel. In our own experience, we are certain that we saw more uterine than breast cancers in the earlier years of our work, while during the past decade the breast cases have been steadily increasing in number so that at the present time the breast cancer cases outnumber the uterine cases. This is perhaps due to the fact that in former times the early bleeding from the uterus caused more alarm and brought the patient to the physician, whereas now women are being taught to bring the early lump in the breast to the attention of their medical adviser.

In child-bearing women, the cervical canal more than any other pelvic part is subjected to severe strain, irritation and injury; yet primary carcinoma prefers to take its origin from some part of the cervical lip, and by no means does it routinely arise from the seat of a cervical tear. In the corpus uteri, it is questionable whether child-bearing is a priori an irritating cause of cancer. We ourselves believe that a degenerating fibroid is a greater factor than formerly believed. Again, we have to ask ourselves, if irritation has a direct bearing upon cancer causation. Why are ninety-seven percent of child bearing women immune, assuming that we allow the large and arbitrary

three percent basis for cancer of the uterus out of the gross total of all cancer which involves the human race? The same reasoning can be applied to cancer of the breast.

Theodor Boveri's "Chromosome Theory" is one of the most ingenious dissertations on the morphology of cancer which we have seen. Throughout the little book, so interestingly written, are many convincing statements, and the theory propounded is not unreasonable and it opens up a wide field of speculation. It seems to have a sound basis and can very well be harmonized with the hereditary theory of Doctor Maud Slye. The latter is, in the writer's opinion, the one outstanding contribution to the incidence of cancer which has successfully withstood adverse criticism. The test of time also seems corroborative.

If we can disregard irritation alone as a primal cause of cancer, may we not assume that two additional factors have to be reckoned with. First, that the types of cancer under discussion show a predilection for a junction point of two epithelial structures, and second, the combined action of constant irritation and physiological function at such points brings on early senility of the cells in these parts so as to invite cancer development.

Finally there seems to be a tendency to turn toward the endocrine system which may after all be the sole custodian of the secret. Here we have the complex mechanism which reigns over the rise and fall of the whole complicated cellular structure, and it is sincerely to be hoped that further studies along this line may bring us nearer our goal.



# ROENTGENOLOGY OF THE ACCESSORY NASAL SINUSES\*

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THE passing decade has proved the importance of eradicating foci of infection. The teeth, the tonsils and the gallbladder have been intensively studied, that the presence of foci might be discovered; and now we find the attention of the medical man, the otolaryngologist and the radiologist centered upon the accessory nasal sinuses. In this brief communication it is our wish merely to recall to attention a forgotten technique, and not to enter into the statistics of a considerable series of cases studied in this manner, nor to undertake a discussion of gross and microscopic anatomy. This we propose doing in a later communication.

The roentgenologist made a large effort to study sinus disease even before he obtained any cooperation from the otolaryngologist. This field, in common with all other fields in medicine, could not be studied by any one specialized group. There must be an active and whole hearted cooperation between all who are concerned, if any important work is to be done. It is only during the past few years that this essential cooperation has existed.

From the mass of ideas of the past to the present time there has come no technique which satisfactorily demonstrates pathology in the accessory nasal sinus. We then arrive at the point where we must choose the procedure which meets our needs best. This each roentgenologist does, and, in consequence, there are more variations of procedure in the study of sinus disease than any other in roentgenology.

The writer has gone through the evolution of this subject along with others, having worked with flat, posterior-anterior, and lateral films, the occipito-mental position; with the  $107^\circ$  angle of Granger, without being able to give to the otolaryngologist the information which he desired.

We were able to give fairly accurate information regarding the antra and the frontal sinuses but practically nothing

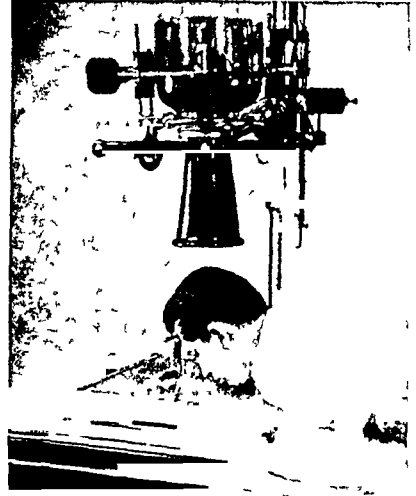


FIG. 1. Shows position of head for films of the antra.

concerning the extent of involvement of the sphenoids or the ethmoid labyrinth. The occipito-mental position for the study of the sphenoid shows very little except increased density because of the multiplicity of overlying structures.

Granger's method is, in his hands, very satisfactory, but this position, it seems to us, is a special study and not satisfactorily adapted for routine examinations—a requisite which must influence the selection of a method.

We attempted to modify Granger's work by making three films in the postero-anterior position, one film at Granger's  $107^\circ$  angle, one at an angle of  $90^\circ$  and still another at  $35^\circ$ . Each of these films could be utilized in the stereoscope. This change gave us more information than flat films, but shadows of structures were present which we could not study properly and the clinicians' verdict was that the method did not give them the information they desired.

\* From the Departments of Radiology and Otolaryngology of the Portland Clinic. Submitted for publication February 27, 1930.

In 1925 we began to work with the Rhiese technique. This technique has been rediscovered at varying intervals since its

exposure tunnel are parallel. The central beam is directed from the opposite parieto-occipital region through the orbit which is



FIG. 2.



FIG. 3.

FIGS. 2 and 3. Show the position of the head and its relation to the sinus board in the Rhiese position. The position is reversed for the left side.

original description and is an oblique exposure of the head. The patient's head is placed on the exposure tunnel with the sagittal plane of the skull at an angle of

in contact with the exposure tunnel. Both sides are done stereoscopically. This position projects both the ethmoids and sphenoids through the orbit. One sees the optic



FIG. 4. Shows the normal ethmoid labyrinth beneath the orbital plane, the sharp clear borders of the sphenoids anterior and below the optic foramen.

about  $23^\circ$  with the tunnel. This elevates the occiput and places the external orbital margin, the nose and the chin in contact with the tunnel.

The plane of the small cone and of the

foramen on the same side, the superior and posterior margins of the sphenoid, and the ethmoid labyrinth. The ethmoids are overshadowed by the sphenoid and the ethmoid cells from the opposite side, but one is per-

mitted to separate these structures by the use of the stereoscope.

It is obviously impossible for the roent-

genologist to separate these structures by the use of the stereoscope. It is obviously impossible for the roent-

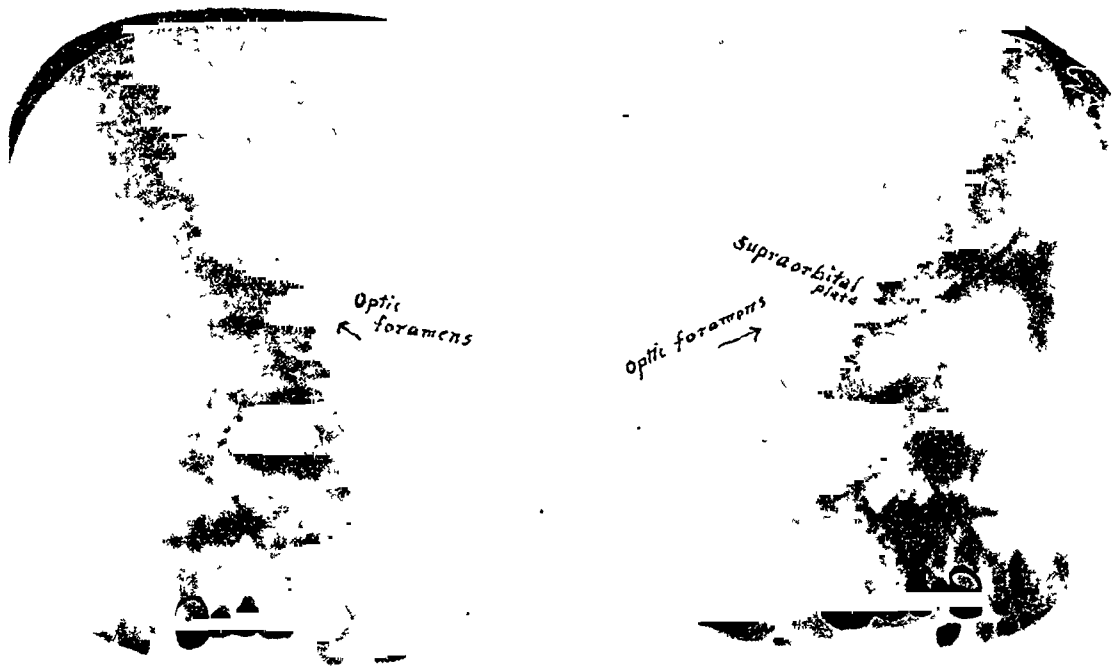


FIG. 5. Shows a chronic hyperplastic ethmoid and both sphenoids. Note the blurring of the margins of the sphenoids and the moderate thickening.

genologist even to translate into terms of roentgen pathology the anatomical pathology present in the sinus, unless he can follow the patient to the operating room or have the benefit of a postoperative conference with the surgeon. At this conference the surgeon must describe minutely the changes which were present and he and the roentgenologist must fit these changes to the varied structural distortions noted on the films. This process of education each roentgenologist must go through if he is to equip himself to give satisfactory opinions. It is not sufficient that he should have the necessary mechanical equipment.

The uninvolved sinus contains air; shows no degree of opacity; the margins of the cells are sharply outlined. We are all familiar with the appearance of the uninvolved antrum and frontal. The ethmoid labyrinth, as shown by the Rhiese position, when uninvolved, will demonstrate the individual cells of the labyrinth

ulae, just as seen in studying the mastoid structure.

The sphenoid, uninvolved, is well illuminated and the posterior and superior borders are sharp and clear. The involved sphenoid, may or may not show a density, but the margins will be blurred or thickened.

In study of these, or for that matter, any sinus film, there are two changes from the normal: First, *an increase in density*, which may vary from a change so slight that it is barely perceptible to a complete opacity. This type of case, however, is one in which nasal examination reveals to the otolaryngologist unmistakable evidence of disease and films are requested principally that the anatomy of the sinus and the extent of involvement may be determined. Second, *slight change in structural characteristics*. This is the type of case in which the internist finds evidence of infection. The patient gives but meager subjective symptoms of sinus disease; and the objective evidence, at nasal examinations,

is not definite. These are the cases that the roentgenologist must prove or disprove if he is to give a real service. To do this we

observe filling defects on the posterior wall, in the Rhiese position, that are not evident in the antero-posterior position.



FIG. 6. Same patient as shown in Fig. 5, with the left sphenoid injected. Note the space between the lipiodol and the bony margins, and the relative positions of the two sphenoids in both views.

must have films which are technically as nearly perfect as possible—films made in a position which will demonstrate to the maximum degree the sinus anatomy; and we must be thoroughly familiar with the roentgen findings in the normal sinus.

In this type of sinus involvement the changes may be only a blurring of the normal sharp, clear borders of the antra, frontals and sphenoids, and of the sharp, intracellular trabeculae of the ethmoid labyrinth; or there may be a definite thickening of the margins and a lack of ethmoid structure. It is the careful study of structure and detail that enables us to give a valuable opinion.

There are many times that our routine examination must be supplemented by the use of some contrast media, for instance lipiodol. In the selection of position for this examination we can find no reason to discard either the Rhiese or Waters positions, for here we have an opportunity to study all the sinuses in both the anterior, posterior and oblique positions. Frequently we are able to

*Summary.* Experience with other methods of sinus examination has brought us to the firm conviction that, at least until a more satisfactory method is devised, the Rhiese position, when stereoscopic films are made, is the most valuable for the routine study of the sphenoids and the ethmoids, and that flat or stereoscopic films in the postero-anterior direction after the manner of Waters gives sufficient dependable information regarding the maxillary antra and the frontal cells.

It has also shown us that the study of margins and structures is of greatest importance; that each individual working in this field must study carefully the anatomical pathology of the cases operated which he has previously studied radiographically; and, lastly, that dependable diagnoses are obtained only when the otolaryngologist and the roentgenologist study the cases together, making a complete opinion from the clinical and roentgenological evidence available at their consultation.

# A NEW COMBINED TECHNIC FOR RADIOLOGICAL EXPLORATION OF THE GALLBLADDER

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SAN JUAN, PORTO RICO

AFTER two years of careful observation, I have reached the conclusion that the usual technic for the exploration of the gallbladder with and without the administration of iodeikon or one of the other preparations utilized for cholecystography may give rise to error, or to doubts which are as prejudicial as errors.

Once the roentgenogram has been made without the previous administration of iodeikon, one either sees nothing or makes out a dark shadow with uncertain contours or he attempts to define the position of the organ by a crescentic deformity of the duodenal bulb in case a barium meal has been given simultaneously, with the result that the flat roentgenogram often proves to be a problem in which all the other problems are combined without clearly setting forth anything.

Sometimes one obtains clear shadows of gallstones, negative or positive, and at other times one obtains the shadow of the gallbladder by virtue of the characteristics of the bile which it contains or the roentgenological conditions of the gallbladder walls; but always one is involved in doubt. Above all one is impressed with the insecurity of the procedure. Bile plus the iodeikon is sometimes sufficient to hide the gallstones.

Making various observations with gallstones of different morphology, dimensions and chemical nature, placed within a small parchment sac, between water bottles equivalent to the coefficient of absorption of the walls of the body, and having obtained roentgenograms with satisfactory technic, it has always been possible for me to obtain sufficient shadows to indicate the presence of the stones. Filling the little sac with bile of various characteristics on various observations nothing appeared or one was simply able to make out the shadow of the artificial gallbladder, which gave one information regarding its position, size and

morphology. Gallstones were only visible when they were of cholesterine or bilirubin plus calcium.

These observations suggested to me a combined procedure which I have practiced frequently with very satisfactory results, and by means of which, moreover, it was possible to reach the necessary logical conclusions to sum up these delicate and difficult studies.

Utilizing the non-surgical biliary drainage of Lyon, the gallbladder is emptied and its contents collected aseptically, after which I expose a series of films under certain definite conditions. I then administer iodeikon either by oral or intravenous route. In some cases, I leave the sound in the duodenum exposing the films with it in place, and by it I slowly inject the iodeikon preparation and at the appropriate hours make new films, administer a barium meal and continue my observations while I do a chemical and bacteriological study of the bile.

The work once done I find myself in condition to establish conclusions concerning the following points:

1. Permeability of the common duct and a functional test.
2. Cytological characteristics of the bile.
3. Bacteriology.
4. Permeability of the cystic duct.
5. Morphology of the gallbladder, anatomical relations, adhesions.
6. Presence or absence of gallstones.

The trouble to which the sum of all this puts the patient is relatively slight when compared to the great benefits which may be derived from establishing a combined diagnosis.

This modest contribution to the non-surgical diagnostic exploration of the gallbladder I offer in the hope that it may merit the compliment of approval and adoption in practice.



# PLEURISY IN INFANTS AND CHILDREN\*

## RADIOLOGICALLY DEMONSTRATED

E. GORDON STOLOFF, M.D.

NEW YORK

### ACUTE PLEURISY

#### DRY OR FIBRINOUS PLEURISY

THE pleurae are not roentgenologically visible in their normal condition and relationship to the other parts of the chest. With the deposition of fibrin, however, even in thin layers a shadow outlining the affected part of the pleura is cast. This is seen as a fine hairline density closely adjacent to the lateral thoracic wall or in the regions of the interlobar fissures. It may be encountered early in a pneumonic process with which pleurisy is associated or later when it is residual to an effusion, serous or purulent. Such hairline shadows are frequently seen in children who have undergone tuberculous pulmonary infection; the pleural thickening overlies a primary focus, a diseased lymph node or a site formerly epituberculous. When part of or the entire surface of the pleura is affected there is a faint homogeneous veiling of the lung over the affected part.

#### FREE EFFUSION IN THE PLEURAE

##### SEROUS OR NON-PURULENT PLEURISY

The initial roentgenological evidence of free serous effusion always manifests itself at the most dependent portions of the chest, in the costophrenic sinuses of the bases. (Fig. 1.) The normally sharp outlines of the diaphragm and costal wall become obscured by a homogeneous shadow which is faint or dense, depending on the amount and depth of the fluid present. The effusion may remain limited. It may increase in amount and extend upwards in the pleural cavity and manifest the extension roentgenologically by an increasing height, width, and density of shadow. From the highest point of the effusion, which lies

laterally in the axilla, the shadow slopes downwards to its most medial point on the diaphragm. In this way is formed the appearance of a triangle whose hypotenuse faces the mediastinum with a more or less convex border. This is the result of:

1. The gravitation of the fluid to the most dependent parts (the posterior and postero-lateral parts.

2. The elastic tension of the lung which pulls on the surface of the fluid causing the most elevation in the axilla where the tension is greatest (Wessler and Jaches).

3. The fact that the inferior lobe is largely posterior and is first to suffer compression towards the mediastinum, thus permitting the largest fluid accumulation in the posterior and postero-lateral portions.

The demarcation of the fluid accumulation is sharply defined in the small and moderate sized effusions. As the amount of fluid increases, the compression and atelectasis of the adjacent margin of the lung increase; a pulmonary shadow is therefore cast which creates a haziness of the otherwise sharp line of the fluid margin. The medial line of fluid effusion not only becomes less sharply defined with increasing quantity of fluid, but tends to become less convex and more horizontal in position. Characteristic of all large effusions is a displacement of the heart and superior mediastinum towards the opposite side, with a depression of the diaphragm of the same side. Shadows cast by fluid are homogenous and dense, obscuring all lung markings. The opacity is greater even than that of pneumonic infiltration and approximates that of caseation.

Associated with the accumulation of large amounts of fluid in the pleural cavity is a widening of the interspaces,

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and a fullness and immobility of the affected side, observed fluoroscopically, which is characteristic for such effusions

contain only a small amount of free fluid. It appears as a band- or ribbon-shaped shadow adjacent to the thoracic wall, due



FIG. 1. Free pleural effusion of moderate extent at left base.

in children. In the early stages of effusion the reverse may be true; one may see a narrowing<sup>1</sup> of the interspaces, which together with a relatively narrowed and immobile chest suggests there is a reflex attempt to modify or arrest the pain of pleural involvement.

#### PURULENT PLEURISY OR EMPYEMA

Empyema may arise in three ways:

1. From a serous effusion which has become purulent.
2. From the rupture of an abscess into the pleural cavity.
3. From a fibrinoplastic exudate arising in pneumonias.

In the first two instances the X-ray appearance does not differ from that of a serous effusion; purulent effusions cannot be differentiated roentgenologically from serous effusions. In the third instance, there is a shaggy fibrinoplastic exudate on the visceral pleura the interstices of which

to the separation of the lung from the chest wall by the fibrinoplastic exudate. This is an early sign of empyema and may antedate the appearance of suggestive physical signs and the presence of free pus on exploration. The shadow may at first be relatively narrow and uniform in width; later it widens and becomes broadest at its base as its fluid content increases and gravitates to the base. The rest of the lung field is clouded if the exudate encases the entire lung or one side of the lung. The peripheral band-like shadow is often seen even in those instances of exudation over the entire lung surface because the rays traverse the entire thickness of the exudate on the edge of the lung, thus causing a summation of the shadow on the posterior axillary, axillary and anterior axillary surfaces. The fibrinoplastic exudate may lie over the upper lobes alone, the lower alone or both. It may be seen over the lower lobes when the

pneumonia affects the upper lung, or over the site of the pneumonic infiltration in which case it is extremely dense on

tic exudate of inflammatory processes leads to the agglutination of opposing surfaces to form sacculations in contra-

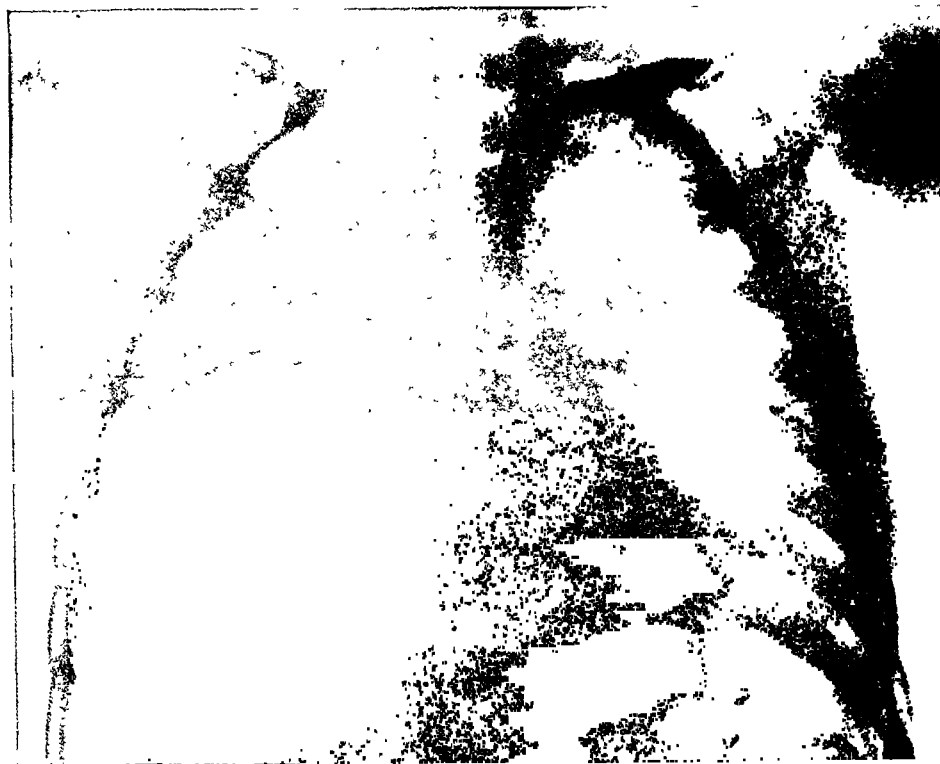


FIG. 2. Encapsulated effusion. Generalized haziness of entire left lung due to early acute pleural affection.

account of intensification by the infiltration. As the amount of free pus increases it approximates more and more the appearance of a free serous or purulent effusion. The demarcation of the diaphragm disappears so that the liver opacity blends with that of the exudate, a sign which during lower lobar pneumonia may be considered as characteristic of empyema (Wessler and Jaches). In the so-called pleuropneumonia there is present early in the course of the disease an extensive, thick, shaggy, fibrinoplastic exudate over the affected lung which appears roentgenologically as a very dense and very broad peripheral band-like shadow with an irregular medial margin. The clinical course is prostrating and early empyema or exitus occurs.

#### ENCAPSULATION OF EFFUSION

Infection plays the decisive rôle in the determination of encapsulation. The plas-

distinction to the transudates of cardiac diseases (Wessler and Jaches).

Encapsulation of purulent fluid is common in the earliest years of life. The effusion may be superficial in the general pleural cavity in contact with the costal wall, or deep (concealed) and not in immediate contact with the costal wall. The apical, basal, and axillary encapsulations are superficial; the interlobar, mesial, mediastinal and infrapulmonary encapsulations are deep. Physical signs of the presence of superficial ones are easy to elicit while those of the concealed encapsulations may defy recognition unless one resorts to roentgenography.

#### SUPERFICIAL ENCAPSULATED EFFUSIONS

Encapsulated effusions which are superficial may occasionally present the appearance of free fluid collections with the tapering fluid borders. The usual appearance, however, is that of homogeneous, dense, more

or less globular or ovoid shadows the shapes of which are modified by the contiguous structures and adhesions. When a

effusion but the presence of râles due to resolving infiltration and unretracted lung confuses the issue so as to delay explora-



FIG. 3. One week later, there is an encapsulated effusion in the left axilla. Medical boundary is sharply defined and medially convex.

free margin is present, it projects into the lung field with a sharply defined, usually convex or globular, outline. Diagnostic for encapsulation is the appearance of a globular, dense shadow projecting from a peripheral or central attachment into the lung field. Occasionally an encapsulated effusion is so large as to occupy almost the entire lung area so that its shadow is continuous with that of the mediastinum and only a small part of clear lung is seen above or below; the upper or lower level is convex upwardly or downwardly, and in the first instance it would be differentiated from a free effusion by the upward convexity. (See Figs. 2 and 3.)

The most frequent site for fluid encapsulation in infants and children is in the axillary region, either at the base or apex. Physical signs may be confusing, particularly in the presence of coexisting pneumonia. The flat note is suggestive of

tion. The localization of the process is important to the surgeon; it must be borne in mind that variations in technique may so alter the shadows as to cause them to appear larger or smaller, or higher or lower, than they actually are. Fluoroscopy, combined with the lateral and the postero-anterior film examination, should be utilized for exact localization before using the exploratory needle. There may be only one sacculation, or several. The outline of the shadow is sometimes suggestive of multiple locules because of a notching, but more often notching is not present or not to be distinguished. The importance of recognition of multiple encapsulations is paramount to the surgeon who without this knowledge may empty but one loculus leaving others untouched. With spreading infection the adjacent pleurae are stimulated to fibrinoplastic exudation which may be observed roent-

genologically as a band shaped shadow projecting downwards or even upwards from the limit of the encapsulated effusion.

#### MESIAL EFFUSION

There is a type of encapsulated effusion which Wessler and Jaches call mesial

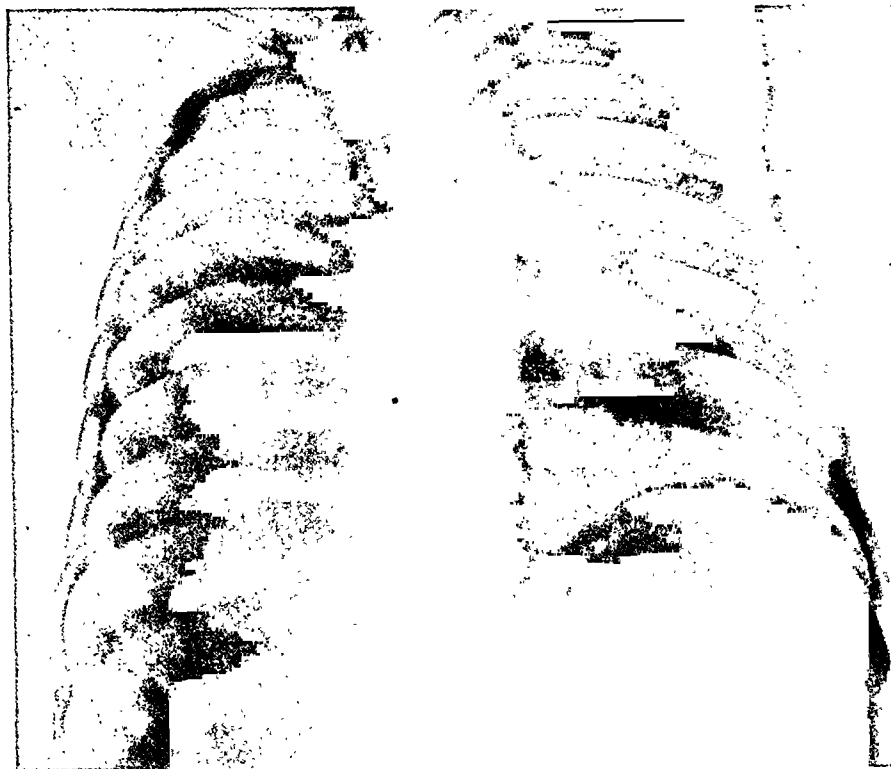


FIG. 4. Extensive infrapulmonary (diaphragmatic effusion) on right side. The upper border is convex superiorly. There is a slight pleural involvement at apex. Operation.

In this way it comes about that new loculi form and that adjacent ones may contain exudates in varying stages of thickness. In the presence of air, just as in the free effusion, the fluid level is easily seen when the patient is in the erect posture.

#### CONCEALED OR DEEP EFFUSIONS

The clinical diagnosis of effusions which are hidden or deep and have no point of contact with the costal wall which would simplify the elicitation of physical signs, must rest in greatest part on the roentgen findings for localization as well as recognition. These effusions by virtue of their position in the interlobar fissures, mediastinum, or on the diaphragm inferior to the lung are usually encapsulated. They may be serous or purulent. Roentgenography and roentgenoscopy in the lateral and oblique positions as well as in the anterior and posterior projection are indispensable in these instances.

because it occurs in that portion of the pleural cavity which borders on the heart. It appears as a dense, homogeneous widening of the mediastinum which in the absence of antecedent clinical history might be mistaken for massive adenopathy. Mesial effusion may be primary but is usually secondary to empyema in other parts of the chest.

#### DIAPHRAGMATIC OR INFRAPULMONARY EFFUSION

Effusions may collect between the pleurae of the lung and the diaphragm and remain localized in this infrapulmonary region. They may also communicate with mediastinal effusions, or parietal ones. When localized, this type of effusion appears as a dense, homogeneous shadow continuous with the heart medially and with the liver when the effusion occurs on the right side. The upper border shows a curve

with the convexity upward. This upward convexity is characteristic of such encapsulation. The effusion may be small or so

mind that the more distant from the screen an object lies the larger will it appear and the greater will be its arc of



FIG. 5. Mediastinal effusion. Large encapsulated effusion encasing left heart. There is some pleural thickening at left base.

large as to extend upward to occupy a large part of the chest. (Fig. 4.)

Such effusions cannot be differentiated roentgenologically from subphrenic abscesses. It is only on operative exploration that the exact relationship to the diaphragm can be determined.

#### MEDIASTINAL EFFUSION

By mediastinal effusion is meant a collection of fluid between the mediastinal and pulmonary layers of the pleurae, without a communication with the general pleural cavity. Adhesions necessarily exist if the effusion is limited to this location. The effusion is either anterior or posterior, or to the left or right of imaginary planes at the roots of the lungs. It is usually unilateral. The localization is accomplished by means of fluoroscopy or roentgenography in the dorsoventral, ventrodorsal, lateral, and oblique positions, bearing in

rotation. As an illustration, an encapsulation on the left side posteriorly will appear larger in the dorsoventral than in the ventrodorsal position. When in the lateral position the left side is closest to the screen, the area of encapsulation will appear smaller than when the right side is adjacent; at the same time its anterior or posterior position may be determined. On rotation of the patient from side to side, the movement of the sacculation will describe a larger arc when he faces the examiner than when the patient faces the tube. The effusion will vary in roentgenological appearance according to its anterior or posterior position. When it is posterior it is usually band-shaped, vertical and parallel to the spine (Savvy, Assman). Its breadth will be modified directly by the amount of fluid present. In the anterior position it takes on a triangular outline with the hypotenuse straight or convex,

facing laterally, the base on the diaphragm, and the other side adjacent to the spine. The shadow is dense and homogeneous.

ance of double contour of the heart from which an effusion must be differentiated. They are: collapse of the lower lobe, retro-



FIG. 6. Lateral view showing multiple areas of lung suppuration with which are associated in interlobar fissures outlining middle lobe.

When there is an effusion in the region of the sinus, where reflection of the mediastinal pleura to the costal wall takes place, together with an effusion in the mediastinum, a costomediastinal effusion is seen (Herrenheiser). Such an effusion posteriorly creates the appearance of an anterior mediastinal effusion, that is, a triangular shadow whose hypotenuses face laterally. Effusions in the posterior mediastinal space are frequently costomediastinal. (Fig. 5.)

When the effusion is marked the shadow may extend beyond the limits of the cardiac density; when moderate or small it lies concealed behind it, particularly on the left side. It is in this way that a double contour of the heart is formed. The summation of both the fluid and the heart densities causes an increased opacity in the region of the effusion. There are other conditions which produce an appear-

cardiac pneumonia, bronchiectasis, Pott's abscess, and adenitis situated posterior to the heart.

Pneumonias, like effusions, are homogeneously dense but their limitations are not as a rule so sharply defined unless there is an interlobar demarcation which in this location would not occur. Pneumonias in regions which come into differential consideration do not appear band-shaped; and, if triangular, the border is not so straight, sharply defined or convex as in the effusions.

Collapse of the lower lobe is roentgenologically similar to an effusion of the anterior mediastinum or to a posterior effusion which is costomediastinal. Here the clinical course and history must aid the differentiation. With collapse, there is always a compensatory emphysema of the upper lobe.

Bronchiectasis may be located in the lower lobes posteriorly and medially. With

it there may be collapse of the diseased lobe, the x-ray appearance of which resembles mediastinal or costomediastinal

Massive swelling of lymph nodes behind the heart, the bifurcation nodes, may be pronounced enough to create a more or less

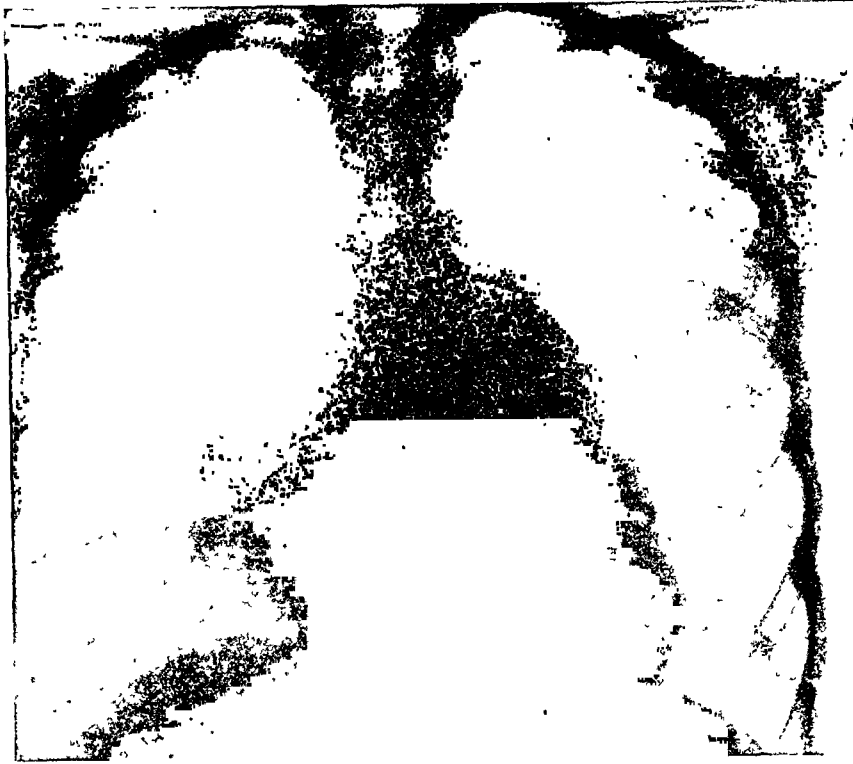


FIG. 7. Communicating pleural effusion between costal pleura and interlobar fissure between right upper and middle lobes.

effusions. An irregular, honey-comb-like shadow or multiple dilatations may be roentgenologically so evident as to immediately indicate the nature of the process. It is sometimes necessary, however, to introduce some contrast-producing substances, such as iodized oil, to outline the dilatations. The clinical history and signs of bronchiectasis, either in the presence or absence of characteristic dilatations, aid the differentiation from effusions of the mediastinum.

In Pott's disease, the abscess may be unilateral and its lower part located in or adjacent to the mediastinum, so that the x-ray appearance may simulate mediastinal effusion. The vertebral column must be examined for a focus or a suggestive narrowing of the intervertebral discs. Pott's abscesses are usually bilateral, not necessarily symmetrically so, more or less elliptical, and associated with manifest disease of the vertebrae.

triangular dense shadow whose lateral margins, however, are usually rounded and perhaps notched, suggesting lymphadenopathy. The swelling is usually bilateral.

#### INTERLOBAR PLEURISY

For the understanding of pleural effusion in the interlobar fissures a visualization of the anatomy of the interlobar fissures is necessary. The lung is as a rule divided by interlobar fissures into an upper, a middle and a lower lobe on the right side and an upper and a lower one on the left. There is, then, a large interlobar fissure on either side separating the upper from the lower lobes and in addition a small one on the right side between the upper and middle lobes. The middle lobe is bounded inferiorly by the lower part of the large fissure. While this is the usual division the presence of aberrant or incompletely separated lobes is not uncommon.

Recently the azygos lobe has been



described roentgenologically and confirmed at autopsy by Wessler and Jaches, Bendick and Wessler, and Stoloff. It is more com-

with the superior vena cava. The azygos lobe is subject to the same pathological processes as the other lobes.

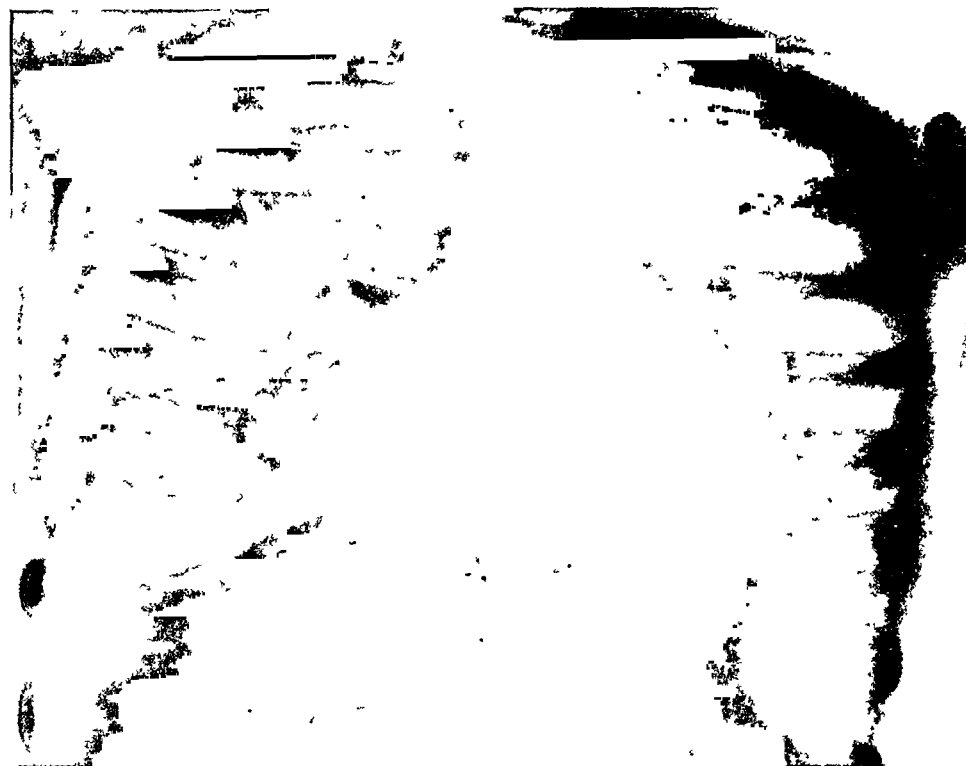


FIG. 8. Homogeneous shadow near right cardiac margin at base, the nature of which suggests infiltration. Left ventricle is enlarged.

monly outlined in the roentgenograms of children than in adults. This lobe is caused by a persistence of the fetal position of the azygos vein which lies lateral to the spine. In its passage from the posterior chest wall to its point of entrance into the superior vena cava the azygos vein traverses the tissue of the right upper lobe. Accompanying it is a reflection of the parietal pleura which occupies the azygos fissure between the azygos lobe and the rest of the right upper lobe. The fissure is outlined by a faint linear shadow, coursing from the apex, either at its midpoint or more medially or laterally, downwards with an outward convexity which varies in depth, to the level of the second costal cartilage where it terminates in a dense button-like, spindle- or comma-shaped shadow about the size of a pea which represents the confluence of the azygos vein

#### TOPOGRAPHY OF THE FISSURES

*Left Interlobar Fissure.* This consists of a line beginning 6 to 8 cm. below the apex at about the level of the third dorsal vertebra, extending from the posterior margin of the medial surface of the lung, backward and slightly upward to the posterior surface, then arching slightly over the posterior convexity and downward, it crosses the fourth interspace in the mid-axillary line, and extends to the level of the sixth costal cartilage, cutting the lung above the cardiac incisure. Thus it makes of the inferior part of the lower lobe what was called by Luschka a tongue-shaped process of lung, which is now known as the lingula. This represents the external markings of the left or great interlobar fissure; the diaphragmatic and mediastinal markings were not portrayed until Fleischner adequately

described them. If the line described in the foregoing is continued dorsally and medially on the diaphragmatic surface

liquely, posteriorly and medially toward the lower part of the hilum. The lung tissue lying anteriorly and medially (the



FIG. 9. Roentgenogram in lordotic position reveals effusion in lower part of large interlobar fissure adjacent to mediastinum, evidenced by triangular shadow protruding laterally.

toward the lower medial margin of the lung below the hilum, then extended, slightly dorsally, upward to the hilum, and from above it steeply to the level of the third dorsal vertebra, the diaphragmatic and mediastinal markings are now completed. Because of the predominantly left-sided position of the heart, only a narrow part of the upper lobe has a diaphragmatic surface.

The right side differs from the left as follows: Right Interlobar Fissure: A line starting at the level of the third dorsal vertebra and extends posteriorly to the posterior convexity of the lung, over which it then arches with a convexity less marked than on the left side, and begins its descent toward the axilla on a less steep incline. The diaphragmatic surface is reached in the anterior or mid-axillary lines, or between the two; from there it takes its course on the diaphragm ob-

middle lobe) thus comprises one-fourth of the diaphragmatic surface. The mediastinal course is similar to that of the left side. The fissure between the upper and middle lobes of the right side is represented by a line practically horizontal at the level of the fourth rib, extending laterally to the great fissure.

If the great fissures are projected on a flat surface, a propeller-like figure (Dietlen) is produced. They may be visualized as oval surfaces which are not plane, lying at an angle of  $45^{\circ}$  with the bases of the lungs and which have been twisted on themselves with the hilum as a fulcrum, so that the upper half faces forward and slightly laterally and the lower half faces forward and somewhat medially. The medial boundaries of the great fissures are less oblique than the lateral ones. The small fissure on the right side, called dome-shaped by Fleischner, which is in-

clined laterally more than anteriorly, has an upward convexity which is more marked dorsoventrally than mediolaterally. Since the fissures vary in depth the lobes may be connected by only a pleural bridge or a small pulmonary pedicle or they may be practically continuous with each other save for a superficial fissure. The pleurae are best thought of as sacs which are so invaginated by the lung that the interlobar as well as the costal, diaphragmatic and mediastinal surfaces, except in the root area for entrance of the vessels and bronchi, are completely covered by a continuous serous membrane which is always in close apposition with another pleural surface.

#### ROENTGEN DIAGNOSIS

Owing to the oblique position of the great interlobar fissure the upper lobe is really in a sense anterior, as is also the middle lobe; the lower lobes are posterior. If there is a small effusion or a thickening of the pleurae in the large slit and the x-ray tube is focussed in the customary position upon the upper dorsal vertebrae, the rays may penetrate through it so that there will be no shadow or at best only a very faint one, for the fissure is narrow and there is an attenuation or subtraction of shadow density by the adjacent aerated lung. The impression on the film or screen will be faint, hazy and not definitely circumscribed. With increasing amounts of effusion or thickening the density increases but it is usually not sharply outlined. Such processes are most commonly located medially and contiguous to the mediastinum, for an interlobar mediastinal pleurisy is frequently present. The density extends from the root of the lung laterally. The shadow is homogeneous and infiltrative processes are suspected.

If a lateral exposure be made the true nature of the pathology becomes apparent. Great penetration must be used in order to differentiate it from the cardiac density. Dependent upon its location (upper, middle

or lower part of the fissure) its length will vary and the amount of exudation or fibrous thickening will determine its thickness. If the involvement be in the upper part, it is seen in the lateral examination as linear or as a band-shaped shadow; or, if there is effusion, it appears as an oval, globular, or elliptical shadow, dependent on the amount of fluid and separation of the pleural surfaces from each other (Fig. 6). This is also true in the lower parts of the fissures. When there is little or no adhesion of the apposing surfaces the fluid content gravitates to the diaphragm and a more or less triangular shadow is produced which rests on the diaphragm and courses obliquely upward and backward.

In the posteror anterior position the exact nature of the involvement may come to light if the fissure is so placed that its greatest length or depth will be horizontal to and traversed by the central rays of the tube. In this manner a summation of shadows is effected and a definite sharply circumscribed shadow is cast. This position may be attained in one of two ways: (1) The lordotic position, first utilized by Fleischner, then by Wimberger, Rach, Stoloff, in which the patient is made to assume extreme lordosis by protrusion of the abdomen while the shoulders are held back; (2) elevation of the tube to a high point, with downward tilting, while the film is relatively low in position (Stoloff). In infants the first technic must be used by holding the patient in lordosis. Older children easily imitate the position after it is demonstrated. The first is the technic of choice.

In roentgenograms made in either manner a shadow appears which is band-like, globular, oval or triangular, and which is sharply circumscribed above and below, standing out clearly in the lung field, and occurring in any part of the fissure. It is usually medial. When there is an associated involvement of the mediastinal pleurae, as is quite frequent, a triangular pennant-like density projects from the

cardiac opacity laterally into the lung field. This is characteristic of a mediastinal-interlobar pleuritis (Fleischner), although it occasionally occurs in the absence of associated mediastinal pleural disease (Figs. 7 and 8). Small effusions cannot be differentiated from thickenings (Fig. 6). As the fluid accumulation increases its nature becomes recognizable, for thickenings do not attain such size nor do they have configurations such as globules or ovals. When the fissure between the middle and the upper lobes is attacked this involvement is easily recognized in the usual dorsoventral position, for the ray in passing through its entire depth the fissure being more or less horizontal, brings about a piling up of the shadow. The roentgenographic image appears as a hairline or a band if thickening or slight effusion is present, or as an ellipse if a larger effusion is contained. Since the fissure is dome-shaped, sometimes more accentuated than at other times, it may have, in a sense, two levels. For this reason two parallel hairline shadows are occasionally seen (Schoenfeld). When mediastinal pleuritis is associated with middle-fissure disease a sudden widening may extend into the cardia, producing the appearance of mediastinal interlobar pleurisy as already described, but the latter is seen in the large fissures only in lordosis.

Several pleural surfaces or combinations of them may be simultaneously affected so that communicating shadows are distributed through a lung field. Thus, there may be a well-defined shadow of effusion in the uppermost part of the fissure separating the upper and lower lobes, continuous with a band-like shadow over the lung indicating free effusion (Fig. 9). On examination in the lordotic position, the lung field may reveal an additional effusion in the lower parts of the great interlobar fissure.

Interlobar pleurisy in children is not uncommon. The most frequent cause is tuberculosis, arising in one of the following ways: the primary focus is adjacent to

the interlobar pleura, or a primary or secondary infiltration lies contiguous to it, or there is a pleural reaction caused by the proximity of the mediastinal limits of the fissures to the diseased regional lymphnodes. At times there are communicating nodes which are actually present within the limits of the fissures, exerting a direct effect on the pleura.

Other causes of interlobar pleurisy are non-tuberculous pneumonias and cardiac decompensation. These are far less frequent.

#### CHRONIC DISEASE OF THE PLEURAE

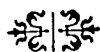
After the resolution of a pneumonic infiltration, a fine hairline or narrow band-like shadow may be seen adjacent to the lateral costal wall, caused by a fibrosis, the sequel to an infiltration. This may gradually disappear or persist for a long time. Such thickenings are frequently seen in the interlobar fissures as well as on the pleurae of the mediastinum. They may follow healed empyemas, tuberculous effusions and dry pleurisies. Where the thickening affects the whole or a part of only one surface, a shadow appears as a homogeneous veiling overlying the involved part. If the lateral parts are free of pleural disease, the customary band-like axillary thickening is not present. Fibrous adhesions between the pleurae and the diaphragm or mediastinum frequently follow in the wake of pulmonary inflammation. Their presence may not be seen but it is suggested from the impairment of movement of the diaphragm or the mediastinum, when the patient is studied fluoroscopically. They are more frequent in older children than in infants. The larger adhesions cast string-like, band-like shadows, or tiny pyramidal projections on the attached part.

Occasionally there is a persistent chronic massive thickening of the pleurae which is seen as a dense homogeneous shadow obliterating the whole or a part of the lung field, and by fibrous adhesions contracting the entire thoracic part. Atelec-

tasis of the underlying lung may be present. The ultimate appearance may resemble that of a massive atelectasis of the lung, with mediastinal displacement and diaphragmatic elevation towards the affected side. The differentiation will rest upon the clinical history and course, with particular consideration of the history of operation or foreign body aspiration.

There are two shadow-casting conditions in infancy and childhood which must be eliminated as confusing factors likely to lead to an erroneous diagnosis of pleural thickening or exudation. The first is the position of the scapula, the inner margin of which may overlap the periphery of the lung, casting a linear shadow parallel to the outer boundary of the thorax. Demonstration of its continuity with the

rest of the scapula will readily differentiate this shadow from a pleural thickening. The second condition is seen in some infants where the ribs at the sternal junctions undergo rachitic widening of the epiphyses, at times so marked that the shadows are continuous one with the other creating an appearance of a ribbon-shaped shadow adjacent to the lateral thoracic wall, simulating pleural thickening or exudation. Close examination, however, will show evidence of rickets, and the clinical history and signs will definitely eliminate pleural disease. In addition a pleural thickening as wide as the shadow cast by a rachitic rosary is usually denser, sharper, more smoothly defined and does not show the multiple medial convexities which outline the epiphyses.



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The American Journal of Surgery is truly independent and enters into no "entangling alliances." It publishes many papers that were read before the leading surgical societies of the Country, but, it is *not* the "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published merely because "it was read at the meeting."

## EDITORIALS

### ABORTION AND CONTRACEPTION

#### FOR INDICATIONS OTHER THAN PURELY MEDICAL

WHEN J. Whitridge Williams, in July 1928, addressed the University of Washington on Indications for Therapeutic Sterilization in Obstetrics,<sup>1</sup> he invited the criticism of his colleagues. In clear straightforward fashion, many of his cases were presented, "so that the justifiability of the course pursued can be criticized." Up to now no one, to our knowledge, has reviewed his opinions, either to approve or to take issue with them.

In a group of 118 women sterilized at his clinic, there were 15 sterilized for mental or psychiatric conditions, and 4 for social indications. Although he has rejected many cases sent to him, because

they do violence to his conscience, he is clear on these. In the rest of the group, and here he believes that few will take serious exception, there are 45 cases sterilized by hysterectomy, or hysterotomy with exsection of the proximal end of the tube, *prior to viability of the child*. This gives him no concern, but he is not at all sure that his procedure in the first 19 cases will meet with general approval. Yet I am disturbed, because, in a specialized obstetrical experience covering many years in two large hospitals, I have not found it necessary to abort or sterilize anyone.

He discussed contraception as well, and,

like him, I find abortion, sterilization and contraception so intimately related, as to make individual treatment from a medical point of view difficult. Abortion is but a by-product of sterilization in many of his cases, and, at best, sterilization is but contraceptive treatment made reasonably certain.

Reviewing his cases briefly, we find 4 cases of pronounced feeble-mindedness, 4 cases of dementia precox, 2 cases of frank psychosis, 1 case of chorea and repeated puerperal insanity, and 1 case of postencephalic depression. Seven of these patients were sterilized during pregnancy, prior to viability of the child.

As to the four social indications. One girl of eighteen with a contracted pelvis, syphilis, tuberculosis and general worthlessness was sterilized at cesarean section in her first pregnancy. Another with 2 microcephalic children had abdominal hysterotomy and sterilization in her third month. A girl of twenty, mental age twelve, was sterilized at her second cesarean section; while the fourth, age twenty-seven who had undergone two cesarean sections and four spontaneous deliveries, was sterilized because she was losing ground physically, had a worthless husband, and could not keep a position if she were constantly pregnant.

Sterilization is widely practiced, with and without much thought on the part of the operator, but often because he is influenced by the desire of the patient or by the pitiful story she tells. In a recent survey of 1805 cases of cesarean section made by the Brooklyn Gynecological Society,<sup>2</sup> sterilization was done in 59 out of 834 cases of contracted pelvis, and in but 16 out of 130 cases of repeated cesarean sections.

Abortion may or may not be the material corollary of contraceptive failure, but apparently it often is. Contraceptive advice is widely given, when, in the physician's opinion, pregnancy would jeopardize life, or even health, through the operation of social or economic factors over which

the physician or the patient have no control. I do not contend that the physician should be prepared to induce abortion, if failure follows his instructions. Not at all. It may be though that there is no middle ground; one may follow the other. Many, however, give birth control information for reasons for which they would shrink from inducing abortion.

But even medical indications are not universally accepted and wide divergence of views exist. We have no one mind upon this important subject. There are 29 birth control clinics in the United States. Let us look at the report of one of them, one which we would expect to be the most conservative. In the First Report of the Bureau of Contraceptive Advice in Baltimore,<sup>3</sup> J. Whitridge Williams analyzed 168 histories of those who had been given advice, and divided them into 4 groups.

In the first group of 70, there were 38 cases in which the indications were tuberculosis, kidney and organic heart disease. There were 14 nervous disorders listed as psychoneurosis, morons, dementia precox, and 1 patient whose husband had a mental affection. The remaining cases comprised syphilis, thyroid disease, epilepsy in the wife or husband, recent operations, fracture of pelvis, encephalitis in the husband, spina bifida, chronic asthma, breast lesion, acute gonorrhoea, and hypertension with difficult labor. A wide and varied assortment of "those presenting definite medical indications." Williams says that in nearly every instance, the indication for advice seemed thoroughly sound.

In the second group of 23, advice was given to those who complained of too frequent pregnancies, with complications listed as undernourished (2), anemia (4), general debility (3), asthenia (3), 15 miscarriages (1), running down (2), husband drunken (1), syphilis (1) and debility (6). Here Williams states that advice was justifiable both from the medical and humanitarian point of view.

The third group Williams admits is

more debatable. Sixty women had an excessive number of pregnancies within a comparatively short space of time. Here the income of the husband was held to be an important factor.

In the fourth group, the historical data were not sufficient for judgment, but Williams feels that he would have agreed had he seen the patients.

That contraceptive advice and treatment may be given as a matter of right, many will deny; but that it is common practice no one will dispute. That medical indications are far flung, this report bears solemn witness. We give advice for run-down conditions and general debility. If general housework were included, no one need have a baby.

There are, however, certain vague but widely accepted indications for abortion. It is easy enough to enumerate medical conditions, but I am sure that clinically the patient is more than a case record. Even those who would agree upon fixed indications, would probably disagree in the management of their cases. Hard and fast lines may not be drawn.

Once we felt that abortion was lawful only if life itself were threatened by continuation of pregnancy, but now serious or even possible damage to health constitutes a valid reason for interference. The child itself apparently is not considered.

There is general agreement that severe kidney lesions call for active intervention. If albuminuric retinitis is a positive indication, hypertension and edema certainly are not. There is much evidence to show that continued pregnancy results in further kidney damage, yet conscientious effort should be made to carry the child to viability.

The case for tuberculosis is not so convincing. In active cases, the risk certainly increases. Parturition, it is said, fans latent lesions to a flame, but there is absolutely no proof that early interference would prevent exacerbations, or that abortion may not be as harmful in its effects as labor itself. In arrested cases,

I believe it does more harm than good. The chief argument against pregnancy is that it is apt to bring about forgetfulness of the lesion and neglect of treatment. But there is no excuse for that.

In heart disease, mitral stenosis or otherwise, early abortion is based upon pure speculation. Broken compensation is not due to the pregnancy, unless the uterus is of sufficient size to cause circulatory embarrassment, a distress due to mechanical factors. Viability should always be awaited and cesarean section considered. Recent advance in the technique of local anesthesia, and the increasing safety of spinal, strengthen this position.

With all this we should be deeply concerned, for there is a changing point of view in the medical profession. Social, economic and eugenic reasons move us deeply. The ethical standards of the public are lower than ever, and the physician has become less and less able to withstand the pressure brought to bear upon him. Medical indications are apt to be loosely accepted at their face value, and a multitude of other reasons find steadily increasing favor with us. Times have changed, and we with them.

Modern life steadily diminishes women's capacity for childbearing. Husbands meet increasing economic stress less willingly. A safer technique and emolument has swelled the ranks of the criminal abortionists. Women are aware of our slackened conscience. Their friends have found honest doctors more sympathetic, more acquiescent, not so deaf as they once were. A little emphasis on this or that point, and her cause is as just as the next one, a vicious circle.

Common sense and thinking for ourselves has brushed aside old religious deterrents. Common contraceptive knowledge has shaken and weakened our moral fibre. Birth control propaganda grows more ardent. We are advised to space our children, to leave little or nothing to nature. "The patient may be advised to make the insertion of the pessary a part



of her evening toilet if desired, so as to be always prepared . . . [it] made a part of the daily routine of undressing." Dilatation, rupture or snipping the hymen to fit a pessary is recommended. "If this procedure were adopted by all young women before marriage, it would save considerable embarrassment and sometimes much pain."<sup>4</sup> "It was the last straw," says another, who possibly inherited his contraceptive beliefs. "I have a very distinct memory, dating from my seventh year, of my discovery of a paper covered book on contraception, carefully hidden away in the top drawer of my mother's wardrobe, and an irreverent member of the family once referred to me as an "accident." So I can only suppose that some attempts at contraception had been made, though of their nature, duration and regularity, I have no exact knowledge."<sup>5</sup> Nothing is sacred. Not even our mothers.

Perhaps we go too far. If adequate reasons for contraception include general debility, general malaise may be added. There was a time, however, when abdominal sterilization, and deliberate destruction of the fetus, not because its presence jeopardized life or even health, but because its eugenic outlook was poor, would be considered a crime akin to infanticide. Perhaps it is.

Fairbairn<sup>6</sup> believes that none other than purely medical considerations should be allowed to influence us. Once other than purely medical factors are allowed to count, no line can be drawn between therapeutic and criminal abortion. "Nothing is worse than the mental torture of

illicit pregnancy," he says. "Are we then justified in terminating these?"

Ethics and morals are not a religious matter. Men may decide upon a basis of morality, it is true, but our conscience is founded upon and guided by something deeper than that. We do not have to invoke divine revelation. Rather do we depend upon the unchanging law of good and evil which is binding upon all of us, and finds its expression in all sorts of principles with which we are constantly in contact. The physician is not the dispenser of life and death. He is not the arbiter of the universe. Individual cases may evoke his pity and wring his heart, but he should feel no call to redress all the wrongs and cure all the wrongs and cure all the ills of society. That would keep us very busy.

To the question, "Have we the right to interfere with a normal pregnancy?" My answer is "No."

CHARLES A. GORDON, M.D., F.A.C.S.

[The author has made out an excellent case against birth-control and the interference of a normal pregnancy. We will be glad to receive other comments on these subjects. Ed.]

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## RADIOLOGICAL DETECTION OF ABDOMINAL ADHESIONS

WE frequently hear it said that the x-ray "failed to show" abdominal adhesions. Pleural adhesions, thanks to the surrounding medium of air in the lungs or in the pleural cavity, can be shown very satisfactorily but

abdominal adhesions are non-opaque to the x-ray.

The detection of intraabdominal adhesions is dependent upon certain circumstances, some of which are under the control of the radiologist: first, the ad-

hesions must fix or seriously limit the excursion of a normally movable, visualizable organ; or, second, in the case of the gastrointestinal tube the adhesions must interfere with the normal onward progress of the visualized contents of the viscus; or, third, pushing or traction by the protected hand or a wooden spoon under the fluoroscopic screen may move some structure so that adhesions may be reasonably inferred from a simultaneous movement of another structure to a demonstrable degree; or, fourth, pneumoperitoneum may be established and the adhesions actually seen.

It is well known that loose intestinal adhesions, even though involving numerous coils of small intestine, often result in no appreciable harm and cause no recognizable mechanical or functional disturbance. The adhesions which really cause trouble are those which by obstruction interfere with the motor mechanism or with the mobility of the bowel, or by traction cause pain. If the adhesions do none of these things (and many cases fall under this heading), then it will be practically impossible to visualize them by any x-ray maneuver except artificial pneumoperitoneum, and this is a major procedure to which many surgeons prefer an exploratory laparotomy. When any such radiologically undemonstrable adhesions are found at operation, the surgeon is very apt to remark that the x-ray did not show them, and to leave an impression that the x-rays are often undependable.

One does not ordinarily see stars in

daylight. The x-ray cannot be expected to do unreasonable things. It is a physical means which strictly follows physical laws. It is quite possible for adhesions to be present even between a normally movable organ and some fixed point without detection on x-ray examination, because at that particular moment the adhesions may not be producing any degree of obstruction. Such a patient examined again during one of his periodical abdominal attacks may show the typical x-ray signs of mechanical obstruction.

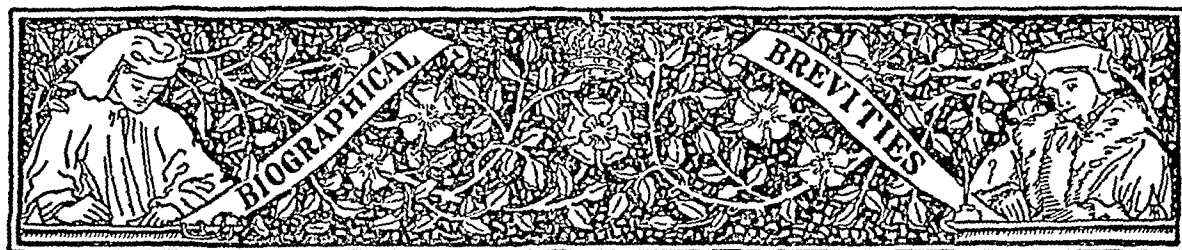
Therefore, when x-ray help is desired in the detection or localization of disturbing adhesions within the abdomen, the radiologist should be acquainted in detail with the problem and he should carry out his examination at such frequent intervals that he may discover even minor aberrations of motor behavior, and watch for a chance to examine in an acute attack. He must carefully manipulate under the screen during deep inspiration and deep expiration, and he must employ change of position and traction or pushing upon the scar or the abdominal wall. Further information may be deduced from a comparison of the films recorded at different times during the examination, noting the relative position of some definite loop of bowel under different circumstances.

In the face of a negative report following such carefully performed examination, adhesions may, of course, be present, but it is extremely doubtful if such adhesions will be helped by any surgical procedure.

JAMES T. CASE.



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## "DUPUYTREN'S CONTRACTION"

**G**UILLAUME BARON DUPUYTREN was a character of varied facets. He was the first surgeon to do so many things; he was the most popular teacher of his day; he was honored as are few physicians; he had no friends; he left his wife and only loved his daughter; he was arrogant, sarcastic, envious of the success of others, had "a brutal lack of consideration for the patients entrusted to his care," and was dubbed by Lisfranc, "the brigand of the Hôtel Dieu."

He was born October 5, 1777 or 1778 at Pierre-Buffière, a small town of Haute Vienne, near Limoges.

In 1789 a cavalry officer, with the permission of Guillaume's father, sent the boy to school in Paris. He attended classes for four years. Due to the effects of the Revolution the school closed. He was determined to complete his studies and at a great sacrifice, enduring true hardship, he finally reached his goal.

When about eighteen he was appointed prosector in anatomy in one of the schools established by Fourcroy.

In 1801 he was made head of his department with the title, *chef des travaux anatomiques*. Among his pupils were Laënnec and Cruveilhier.

In 1804 he successfully competed against Roux and others for the position of surgeon of the second class at the Hôtel Dieu. In time he was the surgeon-in-chief.

In 1812, after a brilliant rise, he was appointed to the chair of operative medicine as successor to Sabatier.

Dupuytren had but one hobby and passion—work. He arose daily at five and began his ward work at six. After morning rounds he gave his clinical lec-

tures in the amphitheater, followed by operations, work in the out-patient division and post-mortem examinations. This finished the morning. During the afternoon he attended to his large consulting practice. In the evening he again made hospital rounds and frequently performed from one to three operations.

This routine year after year was too much for his body. One day while walking to the hospital he was taken with a slight stroke of apoplexy. He recovered and went on a tour of Italy, his first vacation. On his return he tried to carry on his old routine but his health failing he had to relinquish his place at the hospital.

Dupuytren was the first surgeon of his time and the founder of clinical surgery in France. He was the first to demonstrate the nature of yellow elastic and erectile tissue. He proved by animal experimentation that the spleen can be surgically removed with comparative safety. He taught that chronic enlargement of the testis is due to lues. He introduced greatly improved methods of treating fractures. We read he was the first to excise a carcinomatous cervix and the first to describe congenital dislocation of the hip. He changed the current treatment of urethral stricture, using flexible bougies. To this day his name is associated with idiopathic contraction of the palmar fascia, Dupuytren's contraction (1832). He wrote little. As a teacher he was famous.

He was a member of the Institute, a member of the Academy of Medicine and its president in 1824. In 1820 Louis XVIII conferred a baronetcy on him. He was surgeon to Louis XVIII and Charles X.

He died on February 8, 1835.



GUILLAUME DUPUYTREN

[1777-1835]

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BIOGRAPHICAL BRIEFVITIES  
"Dupuytren's Contraction"

*The American Journal of Surgery*  
N. S. Vol. VIII, March, 1930





[From Fernelius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

OLIVER WENDELL HOLMES\*

PHYSICIAN, POET, AUTHOR

FREDERICK C. WARNSHUIS, M.D.

GRAND RAPIDS, MICH.

THERE is a common complaint against the biographies of men, that they are, with few exceptions, insufferably dry reading. The cause is simple in that, if a man has put the best of himself in his work, he has as a rule left little for another to tell. "There are but two people who can tell the story of a man's or woman's life, one is the person himself, and the other is the recording angel." Having no relationship or communication with the latter I may fail in my endeavor to interest you, but when we also recall that Dr. Holmes has written so freely about himself, in the end this paper may possibly become of interest.

An interest in the biography of medical men, as a pastime, has convinced me of its value as an educational factor. In the study of the biographies of the lives of some of the leaders in our profession, I have been impressed that the Hippocratic ideals are realized and exemplified in their lives. If, therefore, those teachers can enlighten us as to the darkness that went before, and the darkness that is to follow, let us hear what they have to teach us, and though we may not as yet perceive any special line of research, we may hold that every addition to our knowledge is

one small step towards the great revelation. But let us proceed without further effusion.

Oliver Wendell Holmes, the son of Rev. Abiel Holmes, a clergyman of the Church of England, was born in Cambridge August 29, 1809. There is little of importance to record of his childhood, suffice it to state that at 15 he entered Philips Academy in Andover. Staying but a year in this institution he matriculated in Harvard in 1825, graduating with what is now known as the "Famous Class of Twenty-Nine." Contemplating the legal profession as his field of work, he studied law for one year in the Dane Law School. In answering the question as to why he relinquished the study of law to enter that of medicine, I can best do so by quoting his words:

What determined me to give up law and apply myself to medicine I can hardly say, but I had from the first looked upon that year's study as an experiment. At any rate I made the change, and soon found myself introduced to new scenes and new companionships.

So from law Holmes turned to medicine. He says in his reminiscences:

At the end of the first year in the Dane Law

\* Submitted for publication September 25, 1929.

School, I took up my new study which was to be my final choice. There is something very solemn and depressing about the first entrance upon the study of medicine. The white faces of the sick that fill the long row of beds in the hospital wards saddened me and produced a feeling of awe-stricken sympathy. The dreadful scenes in the operating theatre, for this was before the days of ether, were a great shock to my sensibilities, though I did not faint as students occasionally do. When I first entered the room where students were seated at a table with a skeleton hanging over it, and bones lying about, I was deeply impressed, and more disposed to moralize upon mortality than to take up the task of osteology which lay before me. It took but a short time to wear off this earliest impression. I had my way in the world to make and meant to follow it faithfully. I soon found an interest in matters which at the outset seemed uninviting and repulsive, and after the first difficulties and repugnance were overcome I began to enjoy my new acquisition and knowledge. The head of the private school at which I studied was Dr. James Jackson, a very wise and a very good man, whose influence on the minds of his students who followed him in his visits to the hospital, and who listened to his teachings, was of the soundest and best character. Dr. Jackson never talked of curing a patient except in its true etymological sense of taking care of him. I think we may say in general that the doctor who talks of curing his patients belongs to that class of practitioners known in our common speech as "Quacks." It is in medicine as in surgery—nature heals; art helps, if she can, sometimes hinders, with the best of intentions; oftener is entirely ignored by the great remedial agencies, ordained by the shaping intelligence, which gives form and life to mortal organization.

Holmes attended two courses of lectures in this private school. If he was to be anything better than a rural dispenser of pills and powders he had to pass, at the very least, two years in European hospitals. Practically this must have been incorporated in the program when his choice of the medical profession was made. Yet so large a part of the "Consideration" received by clergymen was "good," rather than "valuable," that this foreign

education would have been wholly impossible, had it not so happened that the daughter of a prosperous Boston merchant had brought with her into the clerical household a purse not altogether empty; and even with this aid, it would seem that some effort had to be made in order to send the young student to Paris with funds enough in his pocket to enable him to live comfortably, "like a gentleman," as he jealously expressed it. But his father and mother, like true New England parents of that day, came gallantly to the mark and equipped him.

More than once in his writings Holmes refers to his delightful student days in France where he was the follower of the great Louis. His valedictory address to his class in 1882 is largely made up of his reminiscences of his old Paris teachers. The following are his interesting comments on Lisfranc and Ricord.

Of Lisfranc, I can say little more than that he was a great drawer of blood and hewer of members. I remember his ordering a wholesale bleeding of his patients, right and left, one morning when a phlebotomizing fit was on him. I recollect his regretting the splendid guardsmen of the old Empire, *for what?*—because they had such magnificent limbs to amputate. I got along as far as that with him when I ceased to be a follower of Lisfranc.

Speaking of Ricord, Holmes says:

There was also the "Vivacious Ricord," whom I remember calling the Voltaire of Pelvic Literature, a skeptic of the morality of the race in general, who would have submitted Diana to treatment with his mineral specifics and ordered a course of blue pills for the vestal virgins.

Late in November of 1835 he returned to Boston and commenced the practice of his profession in January, 1836. In 1847, he was appointed Parkman professor of anatomy in Harvard, which chair he held for thirty-five years.

As the story of his life goes on it is now that he commences to attract the attention of his friends, and inspires by his life

the enduring reverence of posterity. Follow me while I lead you, somewhat hurriedly, through the succeeding years by portraying him in the rôle of *Anatomist*, and medical *Essayist* with an occasional citation of incidents that reveals the broadness of his character and mind.

#### ANATOMIST

That Holmes should have selected anatomy and dissection as his province of labor may seem a little odd when we are told that he was too tender hearted to practice medicine. Here is what two good witnesses, who have been placed upon the stand, deponeth to his point. Dr. Cheever says:

Too sympathetic to practice medicine, he soon abandoned the art for the science, and always manifested the same abhorrence for death and tenderness for animals. When it became necessary to have a freshly killed rabbit for his lectures, he always ran out of the room, left me to chloroform it, and besought me to not let it squeak.

Professor Dwight says:

In spite of the attention bestowed on dissection, I do not fancy that he much fancied dissecting, though the museum still has some few specimens of his preparation. Once he asked me what part of anatomy I liked best, and on my saying the bones, he replied, "So do I; it's the cleanest."

To better present to you Dr. Holmes in the rôle of anatomist permit me to describe one of his lecture hours. It nears one o'clock, and the work in the demonstrators' room in the old Medical school in North Grove Street becomes even more hurried and eager as the lecture hour in anatomy approaches. Four hours of busy dissection have unveiled a portion of the human frame, insensate and stark on the demonstrating table. Muscles, nerves, and blood vessels unfold themselves in unvarying harmony, if seeming disorder, and the subject is nearly ready to illustrate the lecture. The room is thick with tobacco smoke. The winter light, snowy and dull,

enters through one tall window, bare of curtains, and falls upon a lead floor. The surroundings are singularly bare of ornament or comfort or beauty, and there is naught to inspire the intellect or imagination, except the marvelous mechanism of the poor dead body which lies dissected before us, like some complex and delicate machinery whose uses we seek to know. To *such* a scene enters the *poet*, the *writer*, the *wit*, Oliver Wendell Holmes. Few readers of his prose or poetry could dream of him as here, in this carnal house, in the presence of death. The very long and steep flight of stairs leading up from the street below resounds with a *double* and labored tread, the door opens and a small, gentle, smiling man appears, supported by the janitor, who has often been called to help him up the stairs. Entering, and giving a breathless greeting, he sinks upon a stool and strives to recover his asthmatic breath. Anon, recovering, he brightens up and asks, "What have you for me today?" and plunges, knife in hand, into the depths of his subject. Time flies, and a boisterous crowd of "turbulent Bob Sawyers" pours through the hall to his lecture room door and begin a rhythmical stamping and shouting and pounding. The doors open, a rush takes place, some collapse, some are thrown headlong and three hundred raw students precipitate themselves into a bare and comfortless amphitheatre. Meanwhile the Professor has been running about, now as nimble as a cat, selecting plates, rummaging dusty museums for specimens, arranging microscopes and displaying bones. The subject is carried in on a board; no automatic appliances, no wheels with pneumatic tires, no elevators in those days. The cadaver is decorously disposed on a revolving table, and is always covered with a clean white sheet. Respect for pure humanity and admiration for God's divinest work is the first lesson and uppermost in the poet-lecturer's mind. He enters and is greeted with a shout and stamp of applause. Then silence and there begins a



charming hour of description, analysis, simile and anecdote, which clothes the dry bones with poetic imagery, enlivens a hard and fatiguing day with humor, and brightens to the tired listeners the details of a difficult, though interesting, study. We may say tired listener because the student is now listening to his fifth consecutive lecture that day, beginning at nine o'clock and ending at two. No rest, no recovery for the dazed senses, which have tried to absorb materia medica, chemistry, practice and obstetrics all in one morning. One o'clock was always assigned to Dr. Holmes because he alone could hold his exhausted audience's attention. He came in with a grave countenance. His shoulders were thrown back and his face bent down. No one realized better than he that he had no easy task before him. He had to teach a branch repulsive to some, difficult to all; and he had to teach it to a jaded class which was unfit to be taught anything. The wooden seats were hard, the backs straight and the air bad. The effect of the last was alluded to by Dr. Holmes in his address at the opening of the new school in 1883, in which he referred to those early days as follows:

So when the class I was lecturing to was sitting in an atmosphere once breathed already, after I had seen head after head gently declining and one pair of eyes after another emptying themselves of intelligence, I have said inaudibly, "Sleep on dear youth, this does not mean that you are indolent or that I am dull; it is the partial coma of commencing asphyxia."

To make head against these odds he did his utmost to adopt a sprightly manner and let no opportunity for a jest escape him. These would be received by quite appreciation by the lower benches, and with uproarious demonstration from the mountain, where, as in the French Revolution, the noisiest spirits congregated. He gave his imaginations full play in comparisons often charming and always quaint. None but Holmes could have compared the microscopical coiled tube of a sweat

gland to a fairy's intestine. You will appreciate the aptness of his likening the mesentery to the shirt ruffles of a preceding generation. He has compared the fibers connecting the two symmetrical halves of the brain to the band uniting the Siamese twins.

As a lecturer he was accurate, punctual, precise, unvarying in patience over detail, and though not an original anatomist in the sense of a discoverer, yet a most exact descriptive lecturer; while the wealth of his illustrations, comparisons and similes was unequalled. Hence his charm. The student received information and was amused at the same time. He was always simple and rudimentary in his instructions. His flights of fancy never shot over the hearers' heads. Iteration and reiteration was his favorite motto in teaching. "These gentlemen," he said on one occasion, pointing out the lower portion of the pelvic bones, "are the tuberosities of the ischia, on which man is designed to sit and survey the works of creation." On another occasion in picking up a female pelvis and pointing to the pubic arch he said, "Gentlemen this is the Triumphal Arch under which every candidate for immortality must pass." But if witty, he could also be serious and pathetic, and he possessed the high power of holding and controlling his rough auditors. In earnest himself, enthusiastic, and of happy temperament he shed the glow of his ardent spirit over his followers and gave to his students some of the most attractive and happy hours of their life.

#### ESSAYIST

We have not in mind only his contributions to medical science and literature, which, though overshadowed by his work in general letters, were many and important, but we are thinking of that wider province of the physician that lies beyond the laboratory, the drug shop, the hospital and the consulting room, *the education of the public at large*. Dr. Holmes never lost sight of his profession, and he never

allowed the world to lose sight of it. Throughout his writings from "The Fly in the Stethoscope" to the good-natured raillery at a too exclusive specialism in "Over the Tea Cups," he did not hesitate to hit at its weakness and foibles; while apart from the admirable characters in his novels, he has in many noble passages pictured the life and influence of the true, modest and sacrificing doctor, in terms of the highest appreciation. Holmes is best known to English readers through the Breakfast Table Series, the Autocrat, the Professor and the Poet. These were all written when our author was comparatively young. They contain less direct reference to medical ethics than some of his later works, but even in these we note some very pertinent sayings. In the "Later Day Warnings," a short poem in the Autocrat, after dilating on the duties of legislature, haberdashers, preachers and property dealers, there is a fund of philosophy in these two lines:

When lawyers take what they would give  
And doctors give what they would take.

He evidently despairs of the attainment of this high ideal, for he ends by saying.

But when you see that blessed day  
Then order your ascension robe.

The medical elements are much more noticeable in the "Professor." The following lines are worth remembering by those of us that are apt to look upon ourselves, in our professional capacities, as in the world but not of it.

You can't keep gas in a bladder, and you can't keep knowledge tight in a profession. Hydrogen will leak out and air will leak in, and special knowledge will leak out and general knowledge will leak in, though a profession were covered with twenty thicknesses of sheep-skin diplomas. Till common sense is well mixed with medicine and common manhood with theology, and common honesty with law, we, the people, will crash down upon the lumps of nonsense in all of them, till we have made them like Aaron's calf.

In our relation with patients we might well bear in mind the professor's advice to those about making a choice of a physician:

Be sure you get one with a serene and cheerful countenance. A physician is not, or ought not to be an executioner; and the sentence of death upon his face is as bad as a warrant for the execution signed by the Governor. As a rule no man has the right to tell another by word or look that he is going to die. It may be necessary in an extreme case, but as a rule it is the last extreme of impertinence which one human being can offer to another.

In a discussion as to whether the art of healing makes men hard hearted and indifferent to human suffering, we have a delightful sketch of the ideal doctor in these words:

You may be sure that some men, even among those who have chosen the task of pruning their fellow creatures, grow more and more thoughtful and truly compassionate in the midst of their cruel experience. They become less nervous but more sympathetic. They have a truer sensibility of others pains, the more they study pain and disease in the light of science.

In the Poet, the last of this series, there are some very amusing and highly instructive references to young Doctor Franklin. The following may remind us all of our younger days:

The young doctor has a very small office and a very large sign with a transparency at night big enough for an oyster shop. These young doctors are particularly strong in what they call Diagnosis, an excellent branch of the healing art, full of satisfaction to the curious practitioner who likes to give the latin name to one's complaint; not quite so satisfactory to the patient. Sometimes, in fact, one would rather not know the exact name of his complaint, as, if he does, he is liable to look it up in a medical work, and if he reads, "This terrible disease is attended with vast suffering and is inevitably mortal," or any such statement, it is apt to affect him unpleasantly.

The description of the doctor's office is racy, and I cannot pass on without

relating Holmes description of a patient's interview. I crave your indulgence in this quotation:

With superhuman air of sagacity, with much corrugation of the forehead and fearful concentration of attention Doctor Franklin examined the discolored spot. After dwelling on this most interesting and rare affection and asking if there were any objections to showing the case to the Society of Medical Improvement and Medical Observation, hints are given about Morbus Addisonii. So he gave the patient a prescription, "which," said the poet, "I took care to put where it could do no hurt to anybody, and I paid him his fee, which he took with the air of a man with a great income and said Good Morning. My landlady on seeing the same spot said it was a bump, recommended a piece of brown paper dipped in vinegar; the discoloration soon disappeared." The next interview after Dr. Franklin had had more experience was more satisfactory. The Poet had an ugly cut from a carving knife. It was astonishing to see what a little experience of miscellaneous practice had done for him. He did not ask any more questions about predispositions on the maternal and paternal sides. He did not examine me with the stethoscope and laryngoscope. He only strapped my cut and informed me that it would speedily get well by "first intention."

Dr. Holmes has written three novels all full of medical interest, namely, "Elsie Venner," "The Guardian Angel," and "Moral Antipathy." To begin with "Elsie Venner," this is not the time or place to describe the plot or purpose of the story. I shall therefore dwell on those parts referring to our subject matter. Towards the end of the book we have the following description of Doctor Kettredge:

The old doctor was a model for visiting practitioners. He always came into the sick room with a quite, cheerful look, as if he had a consciousness that he was bringing some relief with him. The way a patient snatches the first look at a doctor's face, to see whether he is reprieved, whether he is unconditionally pardoned or whether he is doomed, has something terrible about it. It is only to be met by an impenetrable mask of serenity, proof

against anything and everything in a patient's aspect. The physician who reflects his patient's condition, like a mirror, may do well enough to examine people for a life insurance office, but does not belong to the sick room. The old doctor came to her (Elsie's bedside), in such a natural quite way, that it seemed that he was only a friend that had dropped in for a moment to say a pleasant word.

In the "Guardian Angel," a delightful story, we will dwell but a moment on one comment of Dr. Holmes on the condition of Myrtle Hazard after she calms down from a series of hysterical attacks. Holmes utters these weighty words:

But all this series of mental disturbance left her in a very impressive state of mind and an excitable condition. This was just the state to invite the spiritual manipulations of one of those theological practitioners who considers that the treatment of all morbid states of mind, short of raving madness, belongs to them and not to the doctors. The same condition was equally favorable for the operations of any professional experimenter, who would use the flame of religious excitement to light the torch of an earthly passion. So many fingers that begin to play on the black keys, stray to the white ones before the tune is played out. Evidently from this we may conclude that the Emmanuel Movement is not of recent origin.

There are many short sayings in this volume which plainly indicate how high Holmes' ethical ideas were. In reference to Myrtle's case I again quote as follows: "Few households have ripened a growth of womanhood without witnessing some of these hysterical manifestations, and its phenomena are largely traded in by scientific pretenders and religious fanatics."

I shall be content with only one more extract from the third volume, in many ways a remarkable book. I refer to "Moral Antipathy." It refers to the ethics of doctors' discussing matters of private interest with their wives. I shall not enlarge as Holmes exactly hits off the danger as follows:

Dr. Butts carried these questions with him. His wife was a sensible, discreet woman,

whom he could trust with many professional secrets. He told her of Paolo's revelation, and talked it over with her in the light of his experience and her own. Mrs. B . . . buried the information in the grave of her memory where it lay for nearly a week. At the end of that time it emerged into a confidential whisper to her favorite sister-in-law, a perfectly safe person. Twenty-four hours later the story was all over the village. Dr. Butts resolves that he would be a little more careful the next time, at any rate, and in spite of every wish to be charitable, he concludes that the worthy lady must have forgotten the rule that "A Doctor's patients must put their tongue out, and a Doctor's wife must keep her tongue in."

From the number of his purely scientific writings on medical subjects, one will always be recalled, "Puerperal Fever as a Private Pestilence." The high estimate in which this work of Holmes is held is demonstrated by the frequent references made to it today by writers on obstetrics. Presuming that all of you have read this medical classic, I am going to quote but one paragraph that has always appealed to me:

It is as a lesson rather than as a reproach that I call up the memory of these irreparable errors and wrongs. No tongue can tell the heart-breaking calamities they have caused; they have closed the eyes just opened upon a new world of life and happiness; they have bowed the strength of manhood into dust; they have cast the helplessness of infancy into the stranger's arms, or bequeathed it with less cruelty, the death of its dying parent. There is no tongue deep enough to record, and no voice loud enough for warning. The woman about to become a mother, or with her new-born infant upon her bosom, should be the object of trembling care and sympathy where ere she bears her tender burden or stretches her aching limbs. The very outcast upon the street has pity upon her sister in degradation when the seal of promised maternity is pressed upon her. The remorseless vengeance of the law brought down upon its victims by a machinery as sure as destiny, is arrested in its fall at a word which reveals her transient claims for mercy. The solemn prayer of the litany singles out her sorrows

from the multiplied trials of life, to plead for her in her hour of peril. God forbid that any member of the profession to which she intrusts her life, doubly precious at that eventful period, should regard it negligently, unadvisedly or selfishly.

Was ever a more beautiful plea made for the expectant mother? Its sentiment is still applicable today.

In the Professor at the Breakfast Table, in comment on this essay, Holmes says:

When by the permission of province I held up to the profession the damnable facts connected with the conveyance of poison from one young mother's chamber to another, for doing which humble office I desire to be thankful that I have lived, though nothing else should come from my life, I had to bear the sneers of those whose position I had assailed, and, as I believe, have at least demolished, so that nothing but the ghosts of the dead women stir among the ruins.

The inquiry is often made as to the exact reason why Dr. Holmes relinquished the practice of medicine. The cause may be found in his farewell address as follows:

Let me begin with my experience as a medical student. I had come from the lessons of Judge Story and Mr. Ashmun in the Law School at Cambridge. I had been busy more or less with the pages of Blackstone and Chitty and other text books of the first year of legal study. More or less I say but I am afraid it was rather less than more. During that year I first tasted the intoxicating pleasure of authorship. A college periodical conducted by friends of mine tempted me into print, and there is no form of lead poisoning which more rapidly and more thoroughly pervades the blood, bones and marrow than that which reaches the young author through mental contact with type metal. "He who has once been a drinker will drink again," says the French proverb, and so the man or woman who has tasted type is sure to return to his old indulgence sooner or later. In that fatal year I had my first attack of lead poisoning and I have never quite gotten rid of it from that day to this. But for that I might have applied myself more diligently to my

legal studies, and carried a green bag in place of a stethoscope and a thermometer up to the present day.

Proud as we are to think of him as a member of our profession, and proud as we are of his achievements in it, we realize that his great work in life had more to do with making people better spiritually than making them well physically. Physician by education, he devoted himself to practice and the acquisition and imparting of scientific knowledge. Poet by nature, he spent his leisure time and declining years in those writings which have so endeared him wherever they have been read. Philosopher, by thoughtful study and love for his fellow men, he made, for many, life's path less rugged by kind and philanthropic words.

The Doctor glided gently and imperceptibly into the period of old age. He came to it in excellent condition both of mind and of body, for he had led a well-regulated life. He had been a hard-working, but never really overworked man, and he had never taken either work or play nervously or tensely. Above all, he had been little preyed upon by anxieties; in the middle path between poverty and riches, with good company, he moved along amid the changing shade of sunshine, by the enchanted hedgerows, enjoying all the possible beauty and peacefulness of the journey through life. In this way he became old by degrees and hardly knew it.

Death drew near with steps so slow, so gently graded that the approach was hardly perceptible. He was out of doors taking his usual walks a few days before the end. He was up and about the house on the last day, and he died, in his chair,

painlessly, as so humane a man well deserved to make his escape out of life, on October 7, 1894.

So passed a way one of the most lovable and notable figures of medicine. A personality pregnant with the perfume of ripe old age, and leaving recollections of a rarely perspicuous and sympathetic insight, a playful and pungent but not caustic humor, and a persuasive benevolence, which was far reaching but discriminating.

Among all his interests two were dominant and transcendent, medicine and literature. By the first he is known to more than a third of a century of students and to the whole medical world, by the second he is known throughout the entire English-speaking world.

In the rush and hurry of our restless life it may be well for us to look back upon the lives of some of the leaders of old, and if by so doing the tension of our mental alertness receives a healthy relaxation, we may consider the time thus spent as not wasted.

"I have only made a nosegay of culled flowers, and have brought you nothing of my own, but the thread that ties them together." Montaigne.

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*Holmes' Medical Essays.*  
*Boston M. & S. J.*, vol. 131.  
*Scribners' Mag.*, 1889.  
*Provincial M. J.*, 1889.

AUTHOR'S NOTE: All claims for originality are waived. This is but a compilation of extracts and paragraphs of many articles that have been read and to whose authors full credit is given for that which I have assembled in an endeavor to transmit a word picture of Dr. Holmes.

F. C. W.

## BOOK REVIEWS

A HISTORY OF THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY. By Colonel P. M. Ashburn. Bost., Houghton Mifflin Co., 1929.

The Librarian of the Library of the Surgeon's General Office should be the logical person to write a well-documented history of

the Medical Department of the United States Army. Colonel Ashburn, the present incumbent of this position, has done the work well. He has not only succeeded in presenting an accurate, authentic work of reference but at the same time has written a volume which makes

interesting reading and he has succeeded in giving what is really an outline of the history of medicine in America. As General Ireland says in the introduction, the story of this department is "a story of honest effort, of continual striving, of unselfish service, of steady improvement, of very honorable and very great achievement, a story we should like for the world to know." General Ireland is too modest in his statements. The story is one that the world of medical men at least *should* know. The story is one of organization, of scientific investigation, of heroism and self-sacrifice. Called upon in the Army posts to handle the usual functions of the family physician, the medical department of the United States Army is at the same time required to handle the most intricate problem of tropical medicine. The laboratory and operating room are of equal importance to this department.

Colonel Ashburn tells his story chronologically and divides it into six parts. Part I covers the Revolution, the War of 1812, the Indian Wars, the Mexican Wars and the Civil War. Parts II and III take from 1873 through the Spanish-American War. Part IV covers the interim between the Spanish-American War and the World War. The latter is covered in Part V, Part VI bringing the work from the World War to date. This volume offers to the surgeon of today not only a literary treat but many surprises as to the activities and interest of "our medical department." If this book is purchased by only a small number of those who *should* read it, a new edition will soon be called for.

BIOGRAPHISCHES LEXIKON der hervorragenden Ärzte aller Zeiten und Völker. Zweite Aufl. herausg. und bearb. von Dr. med. et phil. Franz Hübner, Berlin. Erster Bd. Aaskow—Chavasse. Mit 64 Bildnissen, 936 Zeite. Berlin, Urban & Schwarzenberg, 1929.

"Hirsch's Biographisches Lexikon," published in 1883, has long been the chief source book for biographic material for medical historians. Out of print for some time, it has of recent years been high priced and unavailable to most historians. The new edition is, therefore, particularly welcome at the present time when interest in medical history is being stimulated in all directions.

Carefully edited, printed in a type easy to read, typographically well arranged and with a splendid collection of portraits, with biographic material as to dates of birth, death and

publications readily accessible, the new edition will form a necessary part of the armamentarium of everyone interested in medical history. This today should include practically everyone practising medicine. The new edition is to be complete in 6 volumes, of which only the first is published. We look forward with keen anticipation to the publication of the other volumes and if they are the equal of the one before us, the set will leave little to be desired.

Among the Americans in the present volume are William B. Beaumont, Gurdon B. Buck, J. M. A. Allen, Timothy F. Allen, Henry F. Campbell, John B. and Samuel Bard, etc., from which it will be seen that the "Lexikon" is rather complete.

It is unfortunate to find Sir Thomas Clifford A. Allbutt's name spelled "Alibutt," but a few misprints are unavoidable in a work of this kind and undoubtedly will be taken care of in the reprints.

KYKLOS. Jahrbuch des Instituts für Geschichte der Medizin an der Universität Leipzig. Band I. 172 pp. 1 illus., 1928. Band II. 299 pp. 9 illus., Leipzig, Georg Thieme, 1929.

The first volume, published in January, 1928 and the second of January, 1929, give indications of year books that will be expectantly looked forward to by all interested in medical history. That Volume II should be dedicated to our own Dr. William H. Welch and have his portrait as a frontispiece is a particularly apt tribute at this time when the Welch Institute for Medical History has just been opened in Baltimore. The splendid dedicatory foreword to Dr. Welch is but another example of the internationalism of science. A list of the contents of each volume is appended. The authors and subjects need no comments. No student of the history of medicine will want to be without these volumes and every physician would profit by their perusal. The contents of the two volumes follow:

#### VOLUME I:

##### Vorwort.

1. Abhandlungen aus dem Institute. Der systematische Zusammenhang im Corpus Hippocraticum. Von Owsei Temkin. Zur Grundstruktur der paracelsischen Naturwissenschaft. Von J. D. Achelis. Time-implied Function: an historical Aperçu. By Stephen d'Irsay. Kultur und Krankheit. Von Henry E. Sigerist. Die Alliumarten im Gebrauch der abendländischen Medizin. Von Kurt Heyser Sapientia

artis medicinae. Ein frühmittelalterliches Kompendium der Medizin. Von M. Wlaschky. Ein frühmittelalterlicher Botanicus. Von Erhardt Landgraf.

II. Aus Forschung und Lehre der Medizingeschichte. Die Geschichte der Medizin im akademischen Unterricht. Ergebnisse einer Rundfrage des Instituts. Von Henry E. Sigerist. An historical Dictionary of Medicine. By Stephen d'Irsay.

III. Bericht über die Tätigkeit des Instituts im Jahre 1926/27. Register.

#### VOLUME II:

##### Vorwort.

##### 1. Abhandlungen aus dem Institut.

Die Sonderstellung des Kranken. Von Henry E. Sigerist. Studien zum "Sinn"-Begriff in der Medizin. Von Owsei Temkin. 1. Kritisch-logische Voruntersuchung. 2. Krankengeschichte und Sinnsphäre der Medizin. 3. Moliere und der Sinn der Medizin im 17. Jahrhundert. 4. Epidermiologie und Geschichte der Medizin. Virchow. Von Ernst Hirschfeld. A physiological synthesis. By Stephen d'Irsay. Fragmente zur Arzneygeschichte. Von Hermann Scheer. 1. Warum treiben wir heute Geschichte der Heilmittel? 2. Einleitung zur Geschichte einer Heilpflanze. 3. Mensch und Pflanze. Studien zur Geschichte der Heilpflanzen. 1. Lilium convallium. Von Ernst Hirschfeld. 2. Scilla. Von Ernst Hirschfeld. 3. Zur Geschichte der medizinischen Verwendung des Safran (*Crocus sativus*). Von Maria Tscholakowa. Die Personallehre in der Naturphilosophie von Albertus Magnus. Von Claudius Franz Mayer. Diätetische Wundbehandlung im Mittelalter. Von August Wilhelm Bock. Eine Beschwörung der Gebärmutter aus dem frühen Mittelalter. Von Werner Bernfeld.

II. Aus Forschung und Lehre der Medizingeschichte. Bibliographie der medizingeschichtlichen Arbeiten Karl Sudhoffs aus den Jahren 1923-1928. Nach Materien geordnet von Grete Herbrand.

III. Bericht über die Tätigkeit des Instituts im Jahre 1927/28 Register.

THE VOLUME OF THE BLOOD AND PLASMA IN HEALTH AND DISEASE. By Leonard G. Rountree, M.D., and George E. Brown, M.D., with the Technical Assistance of Grace M. Roth. Phila., W. B. Saunders Co., 1929.

This modest volume is a Mayo Clinic Monograph and its value is guaranteed by the authors, alone, even though the subject is one of great present-day importance. Every

general practitioner who pretends to thorough scientific work and every internist may well spend two or three hours with this book. W. J. Mayo says in the Foreword: "Studies of blood volume give a new outlook on many problems which long were considered settled . . . The pure science of to-day is the applied science of tomorrow."

This book presents the evidence which has accumulated during the last few years relative to observations made with the dye method. The authors have shown the value of the study of the blood volume and plasma volume in clinical medicine.

We earnestly recommend this book.

THE LIFE OF HERMANN M. BIGGS, M.D., D.S.C., LL.D. Physician and Statesman of the Public Health. By C.-E. A. Winslow, DR. P.H. Phila., Lea & Febiger, 1929.

We are here offered the life history in simple language of one of the outstanding figures in modern American medicine. Some of the interesting sidelights taken up include medical science, hospital organizations, public health work and politics from 1859 to 1923. As Dr. Welch says in his preface "Biggs had a genius for leadership and has been justly called a sanitary statesman." The book should prove a source of inspiration to every young physician and medical student. It is truly an idyll of American achievement.

DIE WIEDERBELEBUNG. By Oskar Bruns and Karl Thiel. Berl. Urban & Schwarzenberg, 1930.

This little book on resuscitation should be found interesting and valuable to physicians and surgeons connected with industrial plants. The claim is made by the author that with proper knowledge of resuscitation many an apparently hopeless case, suffering only from electrical shock, may be saved. The subject is well covered and should be in the medical library of every industrial plant today.

ESSENTIALS OF MEDICAL ELECTRICITY. By Elkin P. Cumberbatch, M.A., B.M. (Oxon.), D.M.R.E. (Camb.), M.R.C.P. Ed. 6, rev. & enl. 11 pl., 116 illus., 459 pp. St. Louis, C. V. Mosby Co., 1929.

The sixth edition of this book has been carefully brought up to date. It gives, as its title indicates, the "essentials of medical electricity" as understood at the present time.

PSYCHIATRIE DU MÉDECIN PRATICIEN. By M. Dide and P. Guiraud. Ed. 2. Paris, Masson et Cie, 1929.

Here is a modern, well-written and well-illustrated textbook on psychiatry written for



the general practitioner and of undoubted value to those reading French.

THE PATHOLOGY OF THE EYE. By Jonas S. Friedenwald, M.D. N. Y., Macmillan Co., 1929.

"This book," says the author, "is the outcome of a course of lectures, . . . for the instruction of medical students and surgical house officers in the department of ophthalmology of the Johns Hopkins Medical School and Hospital." As far as may be done in a volume of 350 pages, the author has covered his subject well and, while not intended for specialists, as a comprehensive survey of the subject the book presents a splendid outline of the pathology of the eye for the non-specialist.

THE MEDICAL MUSEUM. Based on a New System of Visual Teaching. By S. H. Daukes, O.B.E., M.D., D.P.H. Lond., Wellcome Foundation, Ltd.

This, the latest publication of the Wellcome Foundation, is not merely a theoretical discourse on medical museums but a report of definite progress. Everyone interested in museums from any angle will profit by a study of this book.

AIDS TO ORTHOPAEDIC SURGERY. By Eric A. Crook M.CH. (Oxon.), F.R.C.S. (Eng.). N. Y., William Wood & Co., 1929.

This volume on orthopedic surgery aims, according to the author, to cover only "that part of the subject of which knowledge is required of the student of general surgery." This purpose is accomplished by the book and not only the student but the general surgeon will find the scanning of this book an excellent method of refreshing his knowledge of orthopedic surgery.

RESEARCH AND MEDICAL PROGRESS AND OTHER ADDRESSES. By J. Shelton Horsley, M.D., Richmond. 6 illus., 208 p. St. Louis, C. V. Mosby Co., 1929.

This volume of 15 essays by Dr. Horsley, of Richmond, Va., covers a great deal of ground as indicated by the following titles of the chapters: Research and Medical Progress; Physiology and Modern Surgery; The Influence of Physiologic Research on Modern Surgery; The Ideals of the Surgeon; The Career of a Surgeon; Shall Surgeons Tell the Truth?; Stomach Trouble; The Mimicry of the Symptoms of Peptic Ulcer; Peptic Ulcer and Cancer of the Stomach; Some Considerations Concerning the Treatment of Cancer; Modern Methods of Preoperative and Postoperative Treatment; The Medical Profession

of Virginia; The Medical Profession of Virginia and State Medicine; Politics and Medicine; The Virginia Academy of Science—Our Fifth Estate. Dr. Horsley also has always something worth saying on each subject and says it well. The volume will repay the short time taken to read it.

ETUDES SUR LES MALADIES FAMILIALES NERVEUSES ET DYSTROPHIQUES. By O. Crouzon. 90 illus., 395 p. Paris, Masson et Cie, 1929.

This book with a preface by Prof. Pierre-Marie covers the subject in a complete and up-to-date manner and presents completely and concisely the ideas of the French school today. Every neurologist and neurosurgeon, who reads French, will want to add this book to his library.

SURGERY OF THE LUNG AND PLEURA. By H. Morriston Davies, M.A., M.D., F.R.C.S. Oxford Press, 1930.

This is a monograph in a series entitled Regional Surgery.

To any surgeon who wishes to keep abreast of the times this book is presented; to the surgeon who deals with affections of the lung and pleura we recommend this well-written and thorough addition to the literature. We feel that the casual surgeon should not attempt many operations made necessary by diseases of the lung and pleura; it is a field for the mature and especially well-trained man, but to the student of surgery and the growing assistant this volume will prove an invaluable aid.

In the last two decades surgery of the lungs and pleura is a bright light in the field of surgical advance and the author of this work handles his subject sanely and thoroughly; the reader soon senses he is reading a finished authority on the subject.

THE TREATMENT OF VARICOSE VEINS OF THE LOWER EXTREMITIES BY INJECTION. By T. Henry Treves-Barber, M.D., B.Sc. N. Y., William Wood and Co., 1929.

This small book of 120 pages gives in every detail essential to the practitioner the technic of the injection treatment of varicose veins of the lower extremities. In a readable and concise manner the author covers the essentials of the modern ambulatory treatment of this common condition. In these days when many men attempt this treatment with an inadequate knowledge of the contraindications, possible complications during treatment and with no



knowledge of the pathology involved it would not be amiss to urge that this worthwhile book be in the hands of many of the profession.

**HEMORRHOIDS.** The Injection Treatment and Pruritus Ani. By Lawrence Goldbacher, M.D. Phila., F. A. Davis Co., 1930.

In the preface the author writes: "The purpose of this book is to present to the medical profession certain practical and readable information regarding hemorrhoids and pruritus ani. The aim has been to make it as brief and simple as possible." The author has succeeded. To any physician interested in these subjects we would be neglecting our duty if we did not write that this small book is a necessary part of the literature and just what a majority of busy doctors of medicine have been looking for.

**TONSIL SURGERY.** By Robert H. Fowler, M.D. Phila., F. A. Davis Co., 1930.

To the true laryngologist this book will prove interesting and the reader will be pleased with the excellence of the publishers' part of bringing it out. The type is large and the illustrations (half-tone and colored) are well reproduced.

To the man who thinks tonsil operations are a part of the general practice of medicine we would like to be able to command that this book must be read ten times and then studied for two years. After this course of reading and study we feel he would be an aid to the public and really know how to do tonsil surgery. That the author has accomplished his aim is sufficient recommendation to any who feel they want a book on this subject.

**TREATMENT IN GENERAL PRACTICE.** By Harry Beckman, M.D. Phila., W. B. Saunders Co., 1930.

This is a necessary book to most physicians. The average student graduates from a medical school well grounded in pathology, physical diagnosis, etc., and except for a few inadequate lectures, it is left to the future for him to discover how to treat his patients. Very often this is accomplished by the literature of drug houses and the beguiling tongues of detail men. And so Dr. Beckman's book is

thrice welcome. We will not go into details but merely leave you with this instruction: If you practice medicine and want a handy book to which you can turn to guide and find advice when in a quandary as to treatment this work is the one we hint that you will not go amiss in buying.

**THE TREATMENT OF COMMON DISORDERS OF DIGESTION.** By John L. Kantor, PH.D., M.D. Ed. 2. St. Louis, C. V. Mosby Co., 1929.

The second edition of this book follows closely the lines of the first edition. Three new chapters have been added on "Common Anomalies of the Colon," "Irritable Colon (Colitis)," and "Organic Diarrheas." There is new material on the vitamins, neutral antacids, cardiospasm, modified Sippy diet, surgical treatment of ulcer, after-treatment of ulcer, etc. For a practical survey of the treatment of the common disorders of digestion the book may be highly recommended.

**MAMMALIAN PHYSIOLOGY.** A Course of Practical Exercises. By E. G. T. Liddell, D.M., and Sir Charles Sherrington, O.M., M.D., D.Sc., F.R.S. Ed. 2, Oxford Univ. Press, 1929.

This is a laboratory book which should prove invaluable to the student of physiology. Having stood the test of two editions, and written by that master physiologist, Sir Charles Sherrington, it may be considered today the last word on the subject.

**ACUTE INFECTIOUS DISEASES.** By J. D. Rolleston, M.D. Ed. 2. Lond., Wm. Heinemann, 1929.

The first edition of this book was published four years ago and the second edition has brought those chapters in which advances have been made up to date. The principal changes have been made in the chapters on diphtheria, typhoid fever, scarlet fever, measles, smallpox and vaccinia. The fact that only one paragraph is devoted to undulant fever and one to tularemia will probably be disappointing to American physicians. It is to be hoped that in the next edition these subjects will be more elaborately treated. The systematic method of handling the subject, the simple language, and the evident authority with which the author speaks make this book an interesting work of reference.



SUPPLEMENT TO

# *The American Journal of Surgery*

A CLINICAL STUDY OF THE  
ABDOMINAL CAVITY AND PERITONEUM

EDWARD M. LIVINGSTON, M.D.

SECTION I. THE CAVITY (CONTINUED)

[In the following pages the Journal page number will be found at the bottom of the page.]

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# A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM

## SECTION I. THE CAVITY\*

### C. THE ABDOMINAL WALLS

#### 2. The Bony Walls (Continued)

THE shape of the abdominal cavity is basically that of a truncated ovoid, but the symmetry of this figure is destroyed by the ingrowth, on the posterior wall, of the vertebral column. The cavity is narrower in the anteroposterior than in the transverse diameter and the narrowest point is situated over the fourth and fifth lumbar vertebrae, or just above the sacral promontory (Fig. 35). During physical examinations this prominent vertebral mass may sometimes be felt, when palpating the anterior abdominal wall. By bearing in mind how closely the anterior and posterior walls may approach one another in the lower lumbar region, the clinical blunder of mistaking the vertebral mass for some abnormality within the peritoneal cavity may be avoided. In confusing cases palpation is best conducted beneath a fluoroscopic screen.

The Lumbar Curvature of the Spine

The abdominal aorta courses along the anterior surface of the vertebral column, running slightly to the left of the midline, and bifurcating at the level of the fourth lumbar vertebra to form the right and left common iliac arteries. It may be mistaken during palpation for a pulsating tumor (aneurysm or solid tumor overlying the aorta). There are instances in which this great vessel may actually be rolled from side to side beneath the palpating fingers as an elongated cordlike mass (Fig. 35, note 2). As a result the diagnostician

Palpating the Abdominal Aorta

\* Preceding installments have appeared as follows: January issue, p. 193; February issue, p. 460.

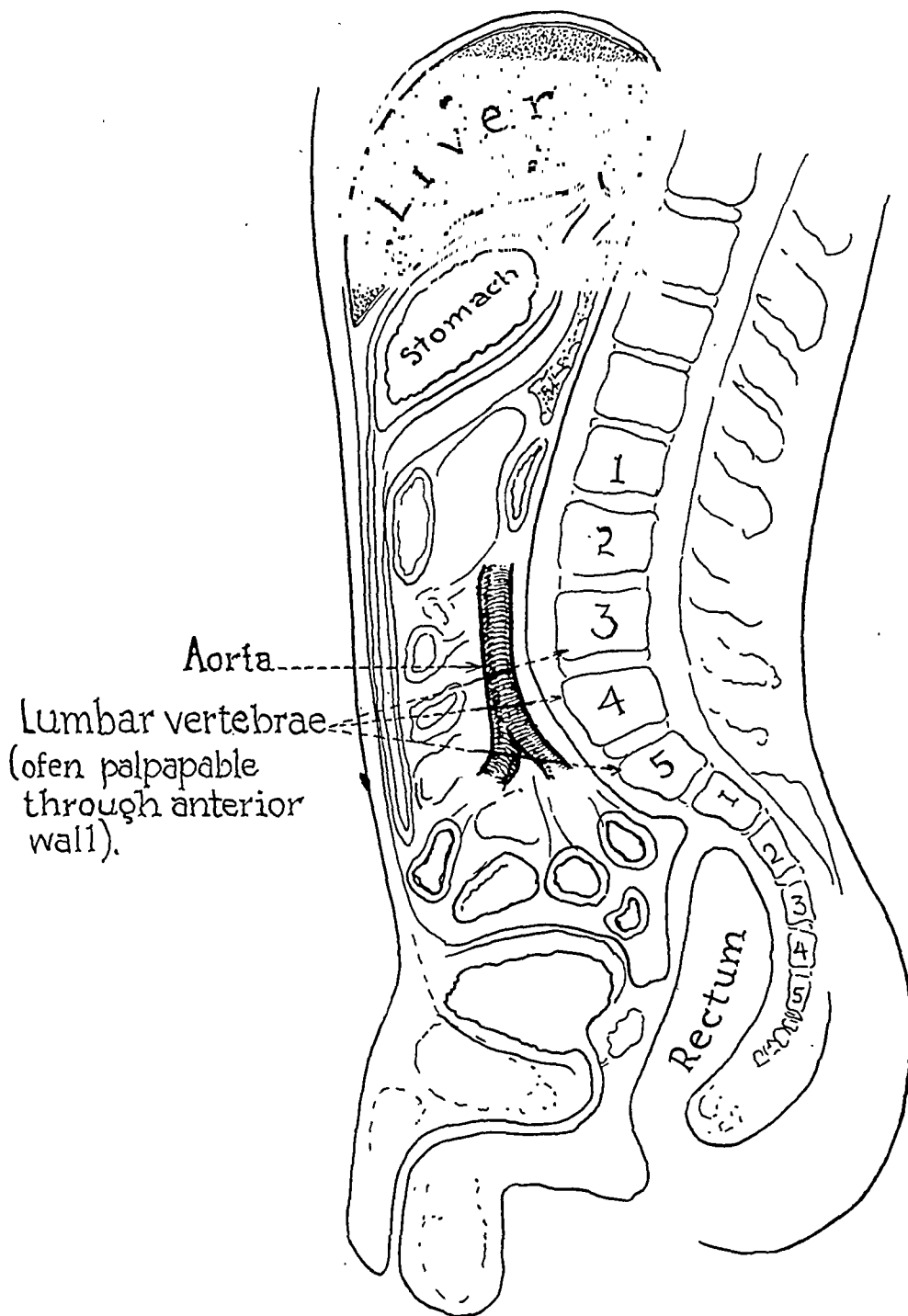


FIG. 35. Cross section of abdomen showing the narrow anteroposterior diameter in the lumbar region.

Note. 1. The vertebral column is often palpable through the anterior abdominal wall and may be mistaken for an abnormal mass.

2. The abdominal aorta frequently may be palpated immediately below the umbilicus.

3. A blow upon the anterior abdominal wall may cause injury or rupture of an intestinal loop by crushing the intestine against the vertebral column.

may be taxed to the limit in his effort safely to identify that which is normal and to exclude that which is abnormal. When the abdominal aorta is plainly felt during an examination, the information which it may impart should not be ignored. It is possible, through palpating this vessel, to estimate the cardiac rate, vigor and regularity. At times this information may be thus obtained with even greater facility than through feeling the radial artery, partially obscured, as it is, between the styloid process of the radius and adjacent tendons. The abdominal aorta is the largest palpable vessel in the body. When seeking other information by abdominal examination the surgeon should add to his observations such data as may be gained through palpating this artery, even though the additional information be recorded in an almost subconscious manner. By such a routine the attention need not be directly diverted to the vascular system but many gross circulatory abnormalities may automatically be detected.

Within the *epigastrium* pulsations from the abdominal aorta are not normally felt. Thorkild Røvsing pointed out<sup>41</sup> that aortic epigastric pulsations occur here only with malpositions of the stomach; he wrote (clinical lectures):

Epigastric Aortic  
Pulsations

One perceives a distinct pulsation in the epigastric region, as I place my hand on the epigastrium, and I feel the aorta pulsating quite close to my finger; you can see, in fact, how my fingers rise and fall simultaneously with the pulse wave. You will never find this with individuals whose stomachs occupy their normal positions. It is merely due to the fact that the stomach, which usually covers the vertebral column like an air- or water-cushion, has glided down from its position into the lower abdomen. It is, therefore, a pathognomonic sign of gastropptosis.

3. *The Soft Parts as a Whole.* Much space is allotted in most surgical reviews of the abdominal walls to a study of incisions and of the anatomy of hernias. The present chapter, however, deals but little with either topic for both are subjects in which the operating surgeon is well versed and both are excellently presented for review in many readily obtainable texts. It has been said (Ochsner) that the "innumerable

The Anatomy of  
Hernias; Abdomi-  
nal Incisions

abdominal incisions which have been described by, and bear the names of, innumerable surgeons" represent that type of non-essential information which exists in many surgical fields and serves to add needless confusion; it represents "a pedantry which often clutters and obstructs the profession." The present aim is intentionally to omit much that is elementary and to avoid confusing non-essentials. The primary object is to suggest new angles from which to consider surgical topics and to attain such an objective it is inevitable that routine values often be disregarded and a logical arrangement of material sacrificed. "To be truly a postgraduate study the topics must be elective." The anatomy of inguinal hernias, then, will be entirely omitted from discussion and details as to methods for incising the peritoneal cavity will be referred to only as the subject arises in other connections.

#### Injuries to the Abdominal Wall

The most important diagnostic problem in regard to wounds of the abdominal wall is to determine whether intra-abdominal structures have been simultaneously injured. It is well known that the same violence causing a simple or closed wound of the belly wall may also produce an open wound (rupture) in some viscus. Morgagni<sup>42</sup> described the mechanism by which the intestine might be crushed against the vertebral column while the anterior wall itself showed little evidence of injury (See Fig. 35, note 3). The literature on this subject has been reviewed by Royster<sup>43</sup> and others.<sup>44</sup> Correct diagnosis is of vital importance for when the pain, shock, tenderness and rigidity are due solely to a solution of continuity within the wall itself, laparotomy is needless; but in the presence of intraperitoneal hemorrhage or leakage of contents from some viscus, an immediate operation is imperative. When it seems certain that the anterior wall alone has been damaged the treatment consists essentially of securing muscular relaxation through posture (flexed thighs, elevated head) and of making appropriate local applications (wet dressings, straps); open wounds are closed in layers, with or without drainage; probing an abdominal

wound is inadvisable. When, upon the other hand, an intra-abdominal injury is known to have occurred, or is strongly suspected, and preparations are being made for operation, the patient should promptly be placed in a semi-sitting posture (Fowler or exaggerated Fowler position) in order to encourage the gravitation of fluids to the pelvis, and adequate doses of morphine should be administered to diminish shock and to quiet the intestinal musculature.

#### Abdominal Perforations

Complete perforation of the abdominal wall constitutes an indication for early exploration to allow prompt repair of damage to any viscus.<sup>45</sup> It has been stated that "the safest treatment for a stab wound that penetrates, or which is suspected of penetrating, is early, careful exploration."<sup>46</sup> About 90 per cent of all gunshot or stab wounds perforate some organ, or organs, over half being those of the intestinal tract. Isolated cases have been reported in which spontaneous closure of small perforations of bowel have undoubtedly occurred<sup>47</sup> and this is explained by the plugging of the aperture by redundant mucous membrane or by omentum and by a reduction of the size of the perforation through a reflex contraction of the intestinal muscles adjacent to the wound.<sup>48</sup> Upon the basis of such reports conservatism might seem permissible when the perforating foreign body is known to have been of small calibre and particularly when the wound is in the upper abdomen, the patient not in shock, and proper conditions for operation not at hand. Yet such delay based upon theoretical grounds and upon isolated or chance reports is not a true conservatism, for early favorable symptoms are frequently followed by sudden fatal collapse and the two chief causes of death following perforation are hemorrhage and peritonitis, neither of which brooks delay. Authorities,<sup>43-45</sup> almost without exception, agree that the outcome of untreated perforations of the intestinal tract is "practically a 100 per cent mortality." Delore went so far as to state that in 1500 cases no patient with a penetrating abdominal wound had recovered under conservative treatment.<sup>49</sup> Even with operative



interference the mortality following gunshot wounds of the abdomen has been found to be 50 per cent both for civil<sup>50</sup> and war practice.<sup>51</sup> It is definitely established, however, that the end-results bear a direct relation to the promptness of operation, just as is true of the operative results from acute peptic perforations where every hour of delay adds to the danger; and in 700 cases studied with reference to the time of operation the mortality varied from 18 per cent in those operated upon within four hours to 87 per cent where operation was delayed beyond twelve hours after injury.<sup>52</sup>

Evidences of Intra-  
Peritoneal Injury

Intra-abdominal damage is indicated by characteristic pain, vomiting, persistent shock, and evidences of internal hemorrhage or visceral leakage. (Fig. 36.) Included in this evidence may be dyspnea, rapid pulse, pallor, shoulder pain, hiccough, absence of liver dulness, shifting dulness in the flanks, leucocytosis, subnormal temperature, absent reflexes. The pain is deep-seated and widespread and is usually first referred to the umbilical region. Associated with shock is cold perspiration, typical pallor, respirations which are superficial and rapid, and a pinched and worried expression which is not readily mistakable. The shock is due to overstimulation and paralysis of the vital reflex centers, vasomotor and respiratory. The vomiting is a reflex through the vagus and it occurs immediately after the injury, but this may be followed by a persistent or recurrent vomiting, often of a mechanical type. Hemorrhage is indicated by a soft and rising pulse, by increasing pallor, "air hunger," and thirst; the leucocyte curve following subserous hemorrhage is characteristic,<sup>53</sup> the count rising rapidly within the first few hours to a 200 or 300 per cent increase above normal, reaching a peak before the sixth hour, and returning slowly to normal by the fourth day; thus interval blood counts studied with reference to the time after injury are of great value. The free fluid gives rise, at times, to shoulder pain, hiccough, and shifting dulness; free gas, even in small quantities, may cause an early obliteration of liver dulness (see section on Intra-abdominal Pressure).

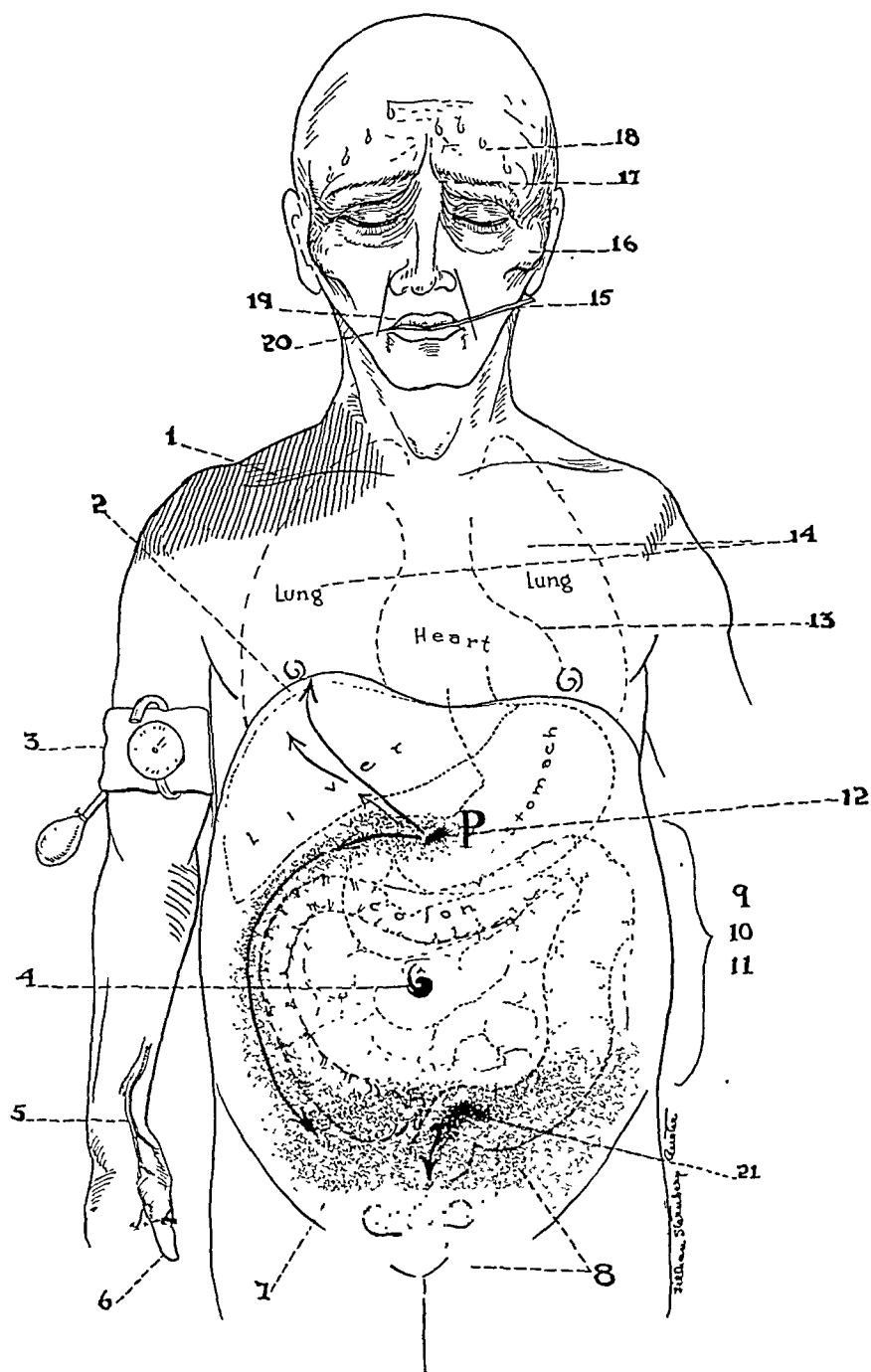


FIG. 36. Graphic study of some signs and symptoms caused by intestinal perforation.

1, Shoulder pain. 2, Free gas, obliterated liver dullness. 3, Altered blood pressure. 4, Umbilical pain. 5, Rapid pulse. 6, Blood cocent. 7, Free fluid. 8, Occult blood. 9, 10, 11, Tenderness, rigidity, dissolution of abdomen. 12, Epigastric pain. 13, Caped heart. 14, Dyspnea. 15, Subnormal temperature. 16, Polor. 17, Pinched expression. 18, Perspiration. 19, Hiccough. 20, Vomiting. 21, Clotted blood in rectum.

[97]

The local examination is of questionable value, since tenderness and rigidity accompany injuries to the abdominal wall as well as those to the viscera. These individual signs and symptoms will be minutely studied in the sections headed Visceral Neurology, The Intestinal Tract, The Solid Organs, and The Peritoneal Membrane. In addition to the general evidences of intraperitoneal involvement are the signs and symptoms of injuries to specific structures. For example, rupture of the bladder may be indicated by such findings as bleeding from the urethra, local extravasations of urine, and an empty bladder upon catheterization. Perforation of the diaphragm, with subsequent diaphragmatic hernia formation, should be considered after any perforating wound in the upper abdomen. Even though the indications of intra-abdominal injuries are numerous and well defined, the following conclusion has repeatedly been restated by many authorities:

There is no sign, or combination of signs, sufficiently constant to indicate the nature of the injury in every case, or to serve as a basis for diagnosis. Exploration is the only definite means for making a diagnosis in season for effective treatment. To wait for definite intraperitoneal signs is often to wait too long, and we should not be deceived into a false sense of security by an improvement in the early symptoms.<sup>54</sup>

Muscle Strain in  
the Anterior Ab-  
dominal Wall

Simple strains of the muscles of the anterior abdominal wall may give rise to signs and symptoms which are readily mistaken for those from more serious affections such as early appendicitis, inguinal hernia, obstructions to the ureter. Such muscle strains should be chiefly thought of with two classes of patients: the young school girl who strains her oblique muscles from vigorous activities to which she has been unaccustomed and the middle-aged man when first resuming strenuous sports after having gained considerable weight.<sup>55</sup> It is important, then, in taking the history in atypical abdominal cases to include an inquiry into any unusual physical exertion during the preceding fortnight.

Desmoid Tumors

It is often difficult to determine whether a given palpable mass is located within the abdominal cavity or within the

abdominal wall. Tumors within the wall itself may exist anterior to the muscles, within the substance of the muscles or beneath the muscles; again, they may be herniated through the muscle layers. Those which are herniated may be detected by their impulse upon coughing; those beneath the muscles are obscured when voluntary rigidity occurs; those within the muscle become fixed and hard as the muscle is contracted whereas they were previously movable; and those situated above the muscles are rendered more prominent as the contractile tissue beneath is made tense. Neoplasms intimately connected with the abdominal muscles are rare, except for the variety known as desmoid tumors or the recurrent fibromata of Paget.<sup>56</sup> Among salient points concerning desmoids are the following; By definition the term means "resembling in appearance a tendon or ligament; ligamentous, tendinous; of firm texture, noting a fibroid or scirrhus tumor" (Gr. *desmos*, a band (tendon) + *eidos*, appearance or form). Desmoids arise, for the most part, in the posterior sheath of the rectus. Rarely are they found in the sheath of the oblique muscles. In three-fifths of all cases they arise in women during pregnancy and are here of rapid growth. This origin is presumably accounted for by minute tears in the muscle and fascia caused by stretching of the belly wall. With women the age incidence is from twenty-five to thirty-five (most active period of reproduction); with men, when desmoids arise, they occur between the thirty-fifth to the fiftieth years. The tumors may be multiple, but as a rule are single. There is a distinct predilection for the lower half of the abdomen and desmoids are more frequent on the right side than on the left. These masses may be slow in growth; when developing rapidly during pregnancy they may diminish in size after parturition. Their typical shape is spherical but this may be modified by the muscle fibers through which they are forced, hence the tumors may become ovoid, or flattened, or have a collar-button shape. When passing beyond their usual size of that of a walnut or egg they take on the characteristics

of a fibromyxoma or fibrosarcoma and may become huge. The typical tumors are hard and solid, with a firm capsule more or less adherent to surrounding tissue. On section the neoplasm has a definite sheen and a tendon-like appearance; it creaks under the knife; its center may show evidences of hemorrhage or calcification. Microscopically, in addition to the typical seeds there may be clusters of rapidly proliferating spindle or round cells and only the postoperative clinical history serves to definitely rule out the diagnosis of sarcoma and establish that of desmoid tumor.<sup>57</sup>

The Line of Congenital Anomalies and Embryonic Defects

The exact midline of the body has been referred to as "the line of embryonic defects." It represents the final site of closure between the two lateral walls of the trunk. Such defects as the following occur along the midline: umbilical hernia, patent urachus, persistent Meckel's diverticulum, epigastric hernia, ectopia vesicae, spina bifida, meningocele, dermoid tumor, imperforate anus. The trained clinician will consider the possibility of an embryonic origin in any tumor, cyst, or fistula which occupies the exact midline of the body. When aware of the congenital nature of the lesion the surgeon is prepared to take the special care or to adopt the special operative procedures usually required with this class of conditions.<sup>58</sup>

Epigastric Hernias

The linea alba between the navel and the ensiform cartilage is at times the seat of small masses varying in size from that of a walnut to that of an egg, known as epigastric hernias (Fig. 37A). The usual site of these little tumors is within 3 in. of the umbilicus. They are of congenital origin and may be of four varieties:<sup>59</sup> (1) Small masses of subperitoneal fat without a sac; (2) such fat tabs with the addition of processes of peritoneum, but without hernial contents; (3) a peritoneal sac containing omentum; (4) a peritoneal sac containing intestine (Fig. 37B). While symptoms may be absent they are often severe, including nausea, vomiting, hematemesis and epigastric pain. The diagnosis of peptic ulcer is often made in the presence of such symptoms, the congenital mass being entirely

overlooked. The confusing symptoms are due to the "dragging" on upper abdominal structures. An operative cure is not difficult to obtain through the use of the Mayo technic



FIG. 37A. The chemical picture of epigastric hernia. (From Quervain.)

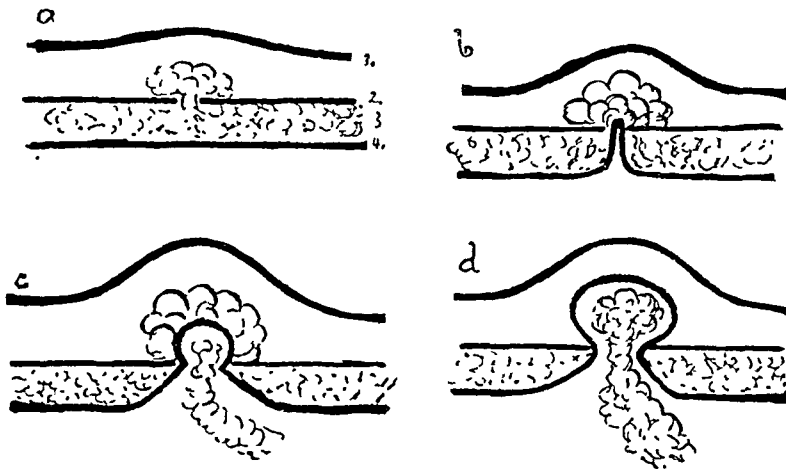


FIG. 37B. The anatomical varieties of epigastric hernia. (epigastric hernia and subserous lipoma). (From Quervain.)

(a) Subserous lipoma, after breaking through sheath of rectus. 1, Skin. 2, Rectus sheath. 3, Subserous fat. 4, Peritoneum.

(b) Subserous lipoma, with some peritoneum pulled up into fascial slit.

(c) Subserous lipoma, with a hernial sac containing some protruded omentum. (Epigastric fatty hernia.)

(d) Simple epigastric hernia, without lipoma.

for dealing with small umbilical weaknesses. The removal of such tumors, though small, should only be attempted

under the most rigid aseptic conditions and under circumstances which make possible a much more extensive procedure than would at first seem required, including intra-abdominal manipulations.

#### The Navel

4. *The Umbilicus.* The umbilicus is of particular interest to the surgeon on account of its location, its permanent venous connections with the portal circulation and its historical relations to the bladder, intestinal tract, liver, vascular system, and peritoneal cavity.

#### Spontaneous Cure of Umbilical Hernia in Infancy

The word umbilicus means (L.) a small pebble or button (the belly-button) and may be used in a non-medical sense for any object which resembles a little pebble, or again, for any small pit or fovea into which such a tiny pebble might fit (an umbilication). The central depression or umbilication of the abdominal wall is caused by an internal traction exerted by obliterated embryonic vessels (the ligaments of the umbilicus). This traction accounts for the spontaneous cure shortly after birth of most congenital umbilical weaknesses. The central location of the umbilicus is implied in the synonym, navel, for, as the hub of a wheel is its nave, or the nave is the name applied to the central portion of a church, so the human navel is a close approximation to the central point on the anterior abdominal wall. The exact location varies considerably, being relatively low in early childhood, and still lower with great corpulency, but is normally situated just above the level of the iliac crests, or opposite the disc between the third and fourth lumbar vertebrae. A third synonym, derived from the Greek, *omphalos* (retained as omphalocele, umbilical hernia; omphalic duct; omphalitis, etc.) likewise means a central object, and was the name of a stone located in the temple of Apollo at Delphi, supposedly marking the exact center of the earth.

#### The Omphalos

#### Umbilicus and the Portal Circulation

For purposes of description the functioning structures at the umbilicus might be termed its "live" parts and those which are purely vestigial, its "dead" parts. Perhaps the most important of the former are the veins which connect the umbilical region and the portal circulation. These travel

from the navel along the round ligament of the liver to empty into the left branch of the portal vein as it crosses the umbilical fossa. Umbilical infections may thus drain into the portal

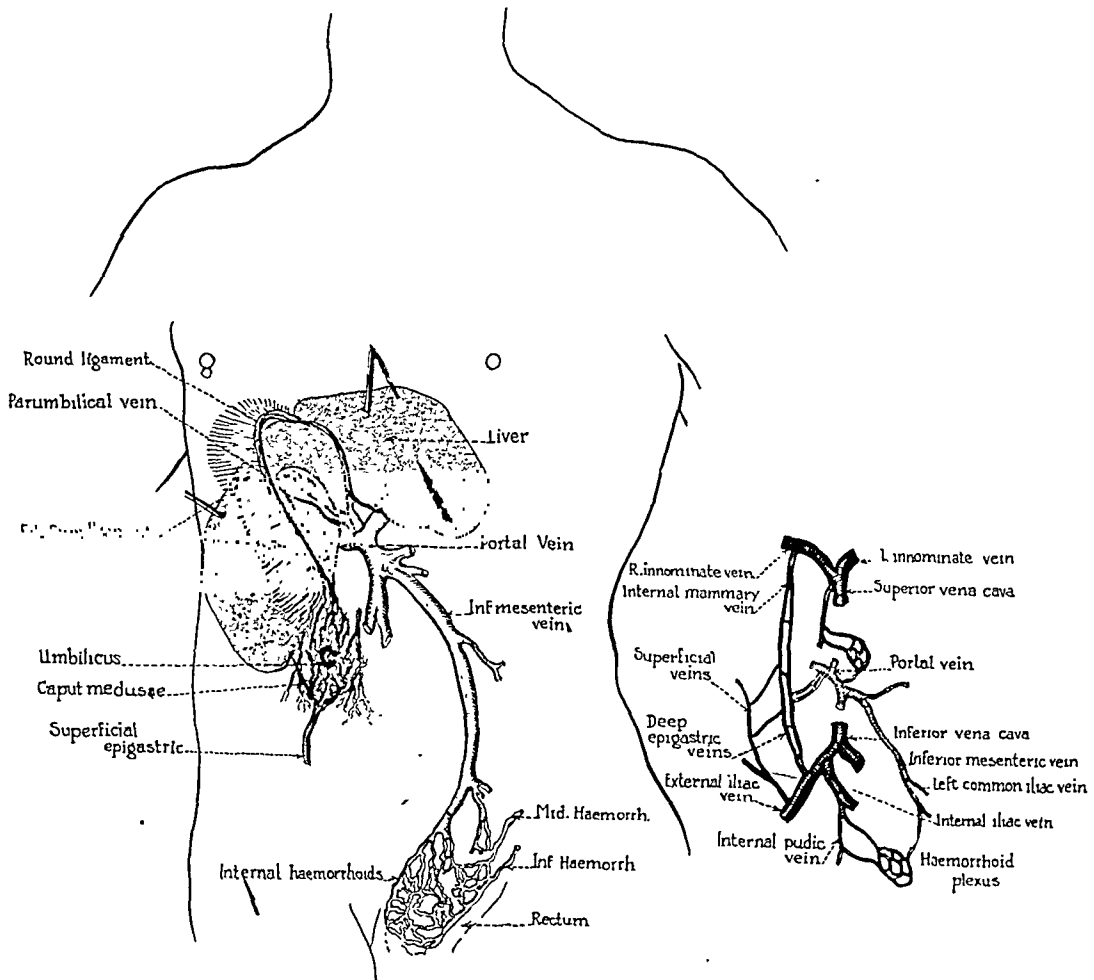


FIG. 38. The caput Medusae.

circulation to cause a secondary pylephlebitis (*pyle*, a gate, phlebitis, inflammation of portal venous system). Again, in cases of portal obstruction from diseases of the liver, back pressure often develops within these veins, causing congestion about the umbilicus. If the obstruction is complete, blood from the portal veins distal to the obstruction may actually flow out through the umbilical veins to reach the systemic circula-



## Caput Medusae

tion through an anastomosis about the navel with the superficial epigastric veins. This gives rise to the phenomenon known clinically as the "caput Medusae" (Fig. 38), so called because of the presence of bluish, radially distributed, snake-like periumbilical veins (Medusa, a mythological character whose hair was transformed into serpents).\*

## "Live Structures of the Navel"

Concerning the other "live" structures of the navel: the nerves are terminal filaments of the anterior branches of the tenth thoracic trunks, interosculating with filaments from the ninth immediately above and the eleventh immediately below; the lymph glands are two, sometimes three in number, lying in the perperitoneal fat, one below and one or two just above the navel, the lower gland draining through lymph vessels to the external iliac glands, and the upper set draining the upper portion of the umbilicus to empty, by efferent vessels, into the inferior anterior mediastinal glands; the arterial supply is chiefly from the superior and inferior epigastric arteries, the former coming from the subclavian artery by way of the internal mammary artery and the latter from the external iliac artery, while both anastomose freely with adjacent branches of the intercostal arteries. The veins, in addition to the ones accompanying the round ligament, follow the arteries and thus ultimately drain both to the inferior and superior venae cavae. Many significant facts regarding these anatomical details are subsequently considered. This brief review merely serves to further the ease with which these essential minute points may be stored in the memory.

## Vestigeal Structures at the Umbilicus

The umbilicus is connected to the bladder by means of a median umbilical ligament (Fig. 39). This is a remnant of the urachus (Greek word for urine) which is that portion of the allantois lying within the body of the fetus. (The allantois, from Gr. sausage + appearance, is a fetal membrane which enters, internally, into the formation of the bladder, and externally into the formation of the umbilical cord and

\* Further consideration is given to the portal and "caval" collateral veins in the sections dealing with ascites and intraabdominal pressures.

placenta). The point of attachment to the bladder of this median ligament is at the bladder vertex. Rarely the urachus fails to close completely, forming a second opening between

Patent Urachus

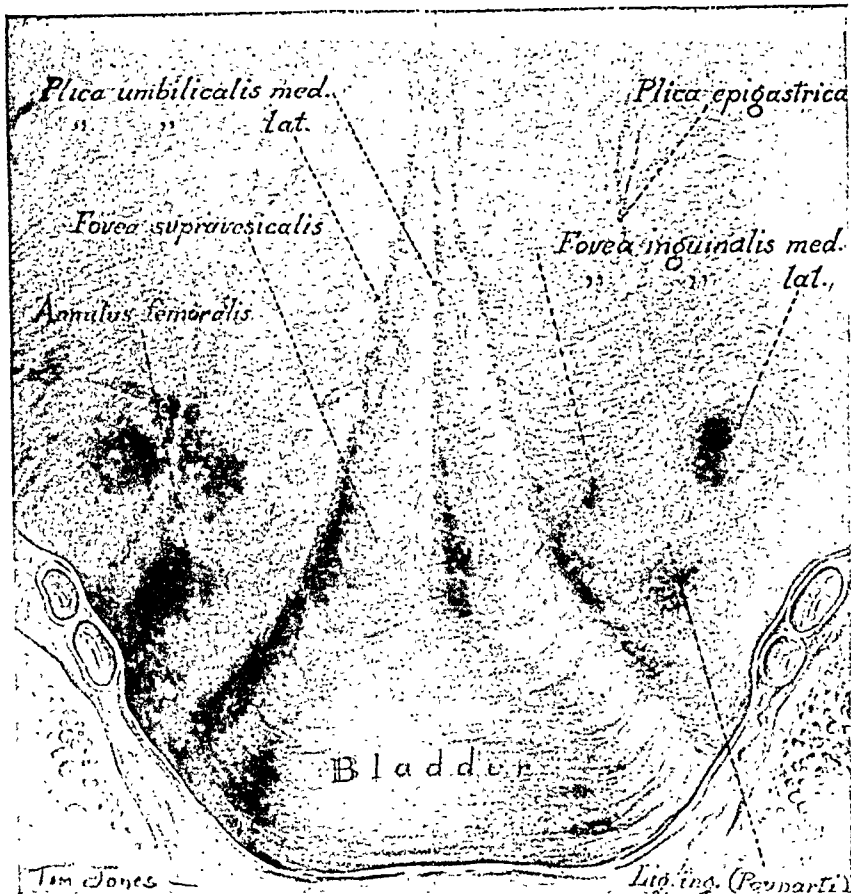


FIG. 39A. Ligaments of the umbilicus.

The median umbilical ligament represents a remnant of the urachus and connects with the bladder vertex. The lateral umbilical ligaments represent the obliterated umbilical arteries and pass to the hypogastric arteries. Note the peritoneal folds or plicae over the ligaments and the peritoneal fossae between the ligaments. (From Hertzler's *The Peritoneum*, Mosby.)

the bladder and the body surface, and causing a discharge of urine or cellular debris from the navel.

To the side of the median ligament run the two lateral umbilical ligaments. These lie beneath the peritoneum,

Significance of the  
Navel Connections  
with Vascular  
Trunks

(plicae lateralis). They pass over the pelvic brim to join the hypogastric arteries (Fig. 39B) (dextra and sinistra). These stout fibrous cords represent the obliterated umbilical arteries.

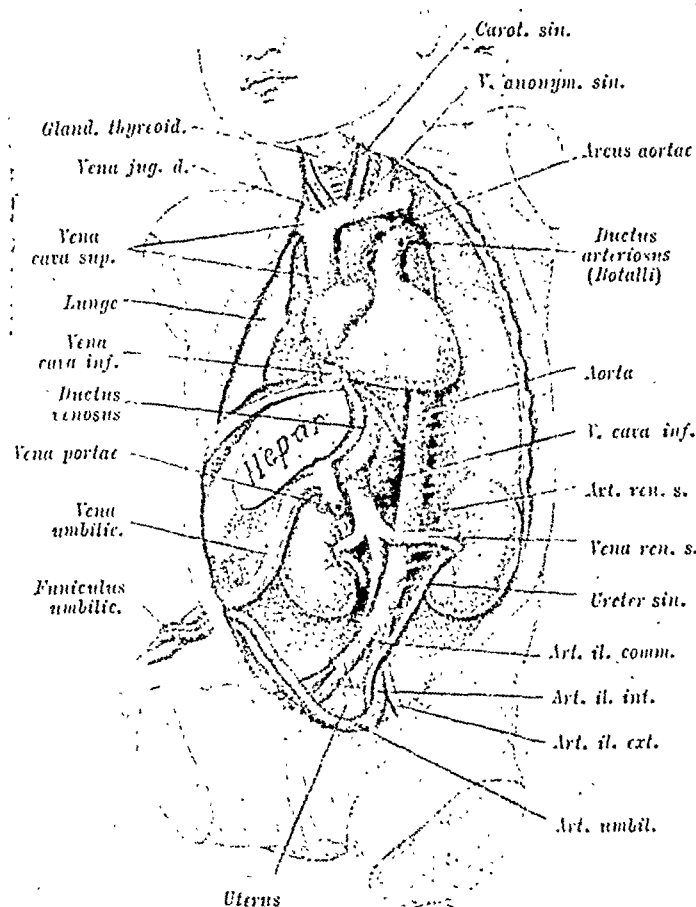


FIG. 39B. Umbilical vessels of the fetus. (From Gegenbaur.)

Their proximal portion, however, is not entirely obliterated, and enough remains patent to give origin to the superior vesical arteries. The chief significance to the surgeon of these lateral ligaments is that they explain the infraumbilical plicae in the peritoneum and that they serve as guides or points of direction. They may prove especially valuable to the surgeon when he is operating in the pelvis where extensive inflammation or neoplastic infiltration has rendered the field obscure. The round ligament of the liver is a fibrous cord derived from

the obliterated left umbilical vein. It travels from the navel to the left branch of the portal vein within the folds of the falciform ligament (described with the liver). Thus in carrying a midline incision past the umbilicus it is necessary to cut to the left of this structure in order to avoid cutting the round ligament. Upon the other hand, the surgeon may intentionally cut the round ligament in order to facilitate rotation of the liver around its transverse axis when unusual difficulty has been experienced in exposing the cystic and common bile ducts. In such instances the ligament is to be repaired before the abdomen is closed.

Rotation of Liver

From this summary it is seen that in the fetus three vessels pass through the umbilicus, the vein travelling directly upward and the two arteries travelling obliquely downward within the abdominal cavity (Fig. 39B). One remaining fibrous cord from an obliterated vessel is inconstantly present at the umbilicus, namely a band passing from the superior mesenteric artery, over the intestinal wall to the navel and representing an old means of nourishing; the primitive yolk sac.<sup>60</sup> (The origin and significance of this cord may be read in the original words of Meckel in the section dealing with eponyms, p. 128.) Such a free band, when present, passing from gut wall to umbilicus, may be the cause of an internal hernia, or band obstruction of the bowel.

The most common connection between umbilicus and enteral canal (Meckel's diverticulum) is discussed in a review of the intestinal tract (Fig. 40.). When present (2 per cent of cases) and patent (exceedingly rare) this may cause a discharge of intestinal content through the umbilicus. A rudiment of the diverticulum of Meckel may also account for deep entodermal neoplasms in the midline below the umbilicus. In addition this rudiment may give rise to many varieties of internal hernias, strangulations, or even autoanastomoses of the bowel (see Treves<sup>61</sup>).

Meckel's  
Diverticulum

The umbilicus is a final point of closure in the abdominal wall and within its fibrous ring, which is derived from the

Umbilical Hernias

linea alba, the peritoneum, fascia and skin are closely adherent, while muscle is entirely absent. During development the opening of the umbilical region is of huge size, at one time

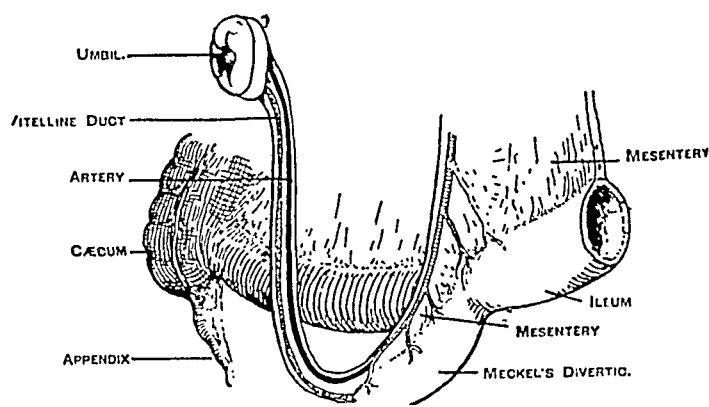


FIG. 40. Meckel's diverticulum, the remains of the vitello-intestinal duct, and of the artery to the yolk-sac. (From Treves.)

being equal to one-fourth to one-third the entire length of the embryo. At the sixth week of intrauterine life the navel remains large, is funnel shaped and normally contains a loop of bowel to the apex of which is attached the omphaloenteric duct (duct of yolk sac). Because of these facts hernias at this point might reasonably be expected with higher incidence than is actually found clinically. In rare instances the loop of gut fails to return to the abdomen proper and cases are recorded in which the accoucheur has severed bowel when cutting the cord.<sup>62</sup> Minor weaknesses of the navel, often observed at birth, tend to close spontaneously as the umbilicus is drawn backward and downward by its ligaments for the body wall continues to grow while the ligaments degenerate from the time when the umbilical cord is ligated and severed. Permanent umbilical weakness may give rise to hernias which vary in size from minute openings admitting but the tip of the little finger to huge masses containing large amounts of omentum, transverse colon, stomach, small bowel, etc. Coughing, straining and lifting, blowing the nose, and performing any act which increases the general pressure within the abdomen tends to aggravate the symptoms and increase the

degree of herniation. The increased size of the abdominal and peritoneal cavities caused by larger hernias leads to hypertrophy of the structures occupying the sac, and to an



FIG. 41. Side view of a case of umbilical hernia. (From Eisendrath's Surgical Diagnosis, Saunders.)

increase in the total amount of intra-abdominal fat (Fig. 41). So great is this increase in substance that the content of the large hernias is often reduced only with the greatest of difficulty and the high mortality following repair of such umbilical masses is thought to be intimately associated with the increased crowding and pressure within the abdomen following closure of the wall.<sup>63</sup> (See Intra-abdominal Pressure). So close is the adherence of skin and peritoneum over umbilical hernias

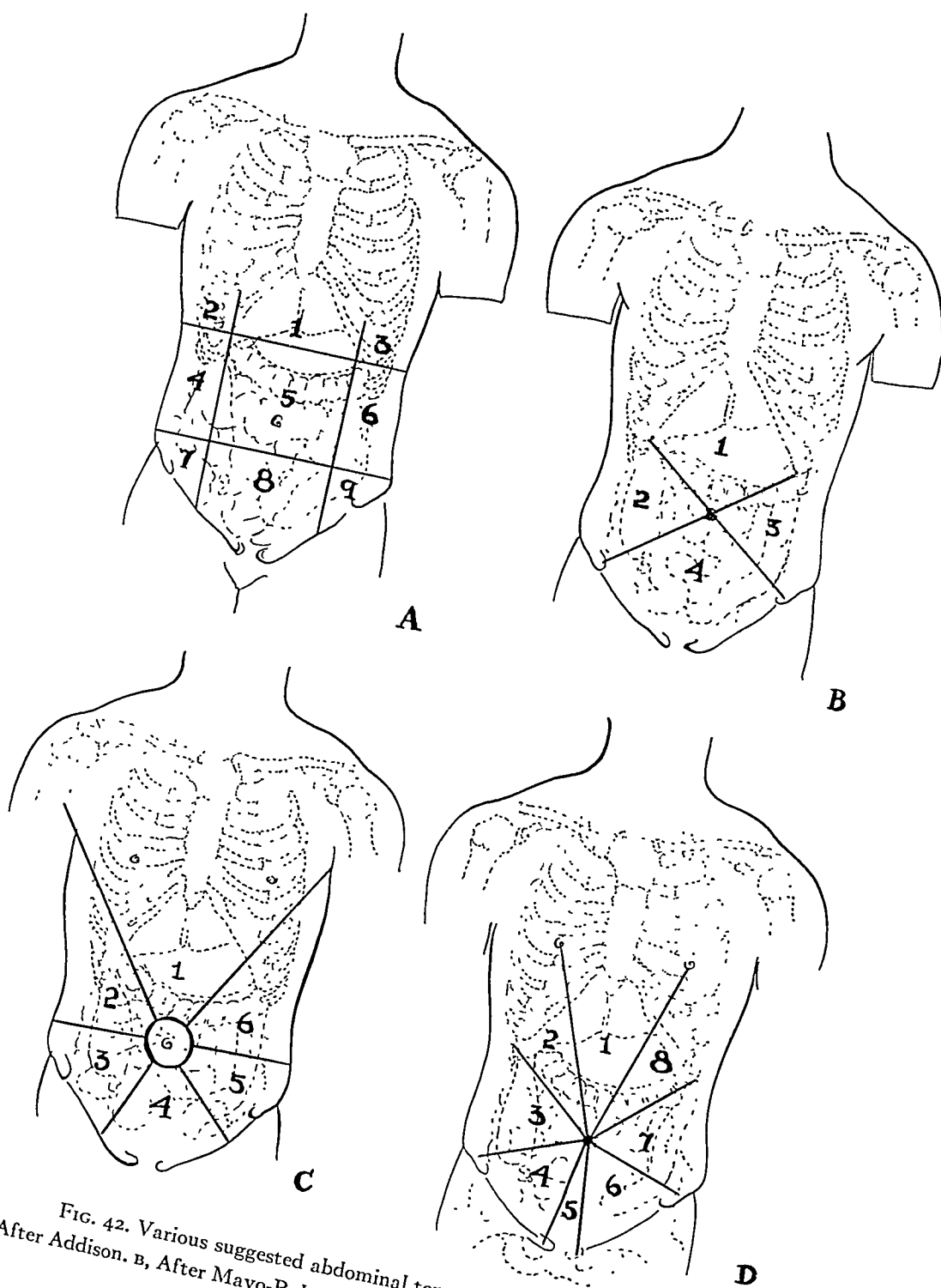


FIG. 42. Various suggested abdominal topographical markings.  
 A, After Addison. B, After Mayo-Robson. C, After Anders. D, After Hertzler.

SUPPLEMENT: A. J. S., n. s. Vol. VIII, No. 3, p. 714

that the sac is almost always opened with the skin incision unless this be carefully made at one side of the mass. The danger of thus accidentally opening peritoneum is obvious.

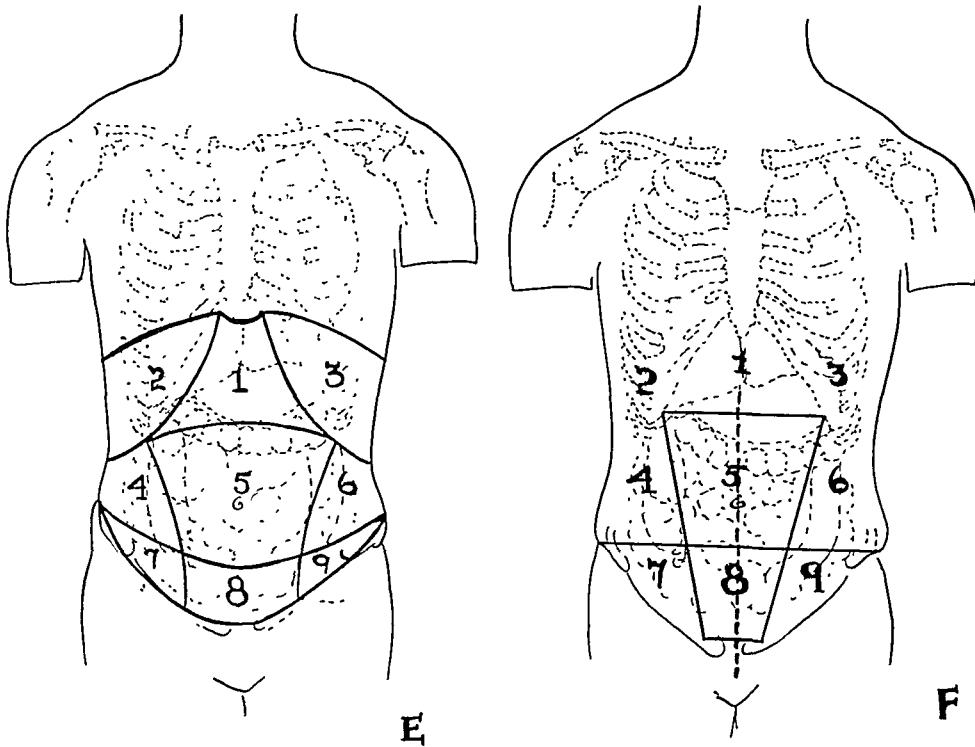


FIG. 42. (Continued.)

E, After B. N. A. System. F, After Barker.

5. *The Vessels and Nerves of the Abdominal Walls.* These will be dealt with in special chapters.

#### D. ABDOMINAL TOPOGRAPHY

The object of abdominal topography (Gr. *topos*, place, + *graphe*, a description) is to describe intra-abdominal structures in relation to definite and limited areas on the surface. The exact attainment of this objective is by no means easy. Organs are dealt with which are movable. Tumors and other abnormalities must be described which adhere to no fixed limits. Even the surface on which the measurements must be taken is itself subject to considerable individual and postural

Problems in  
Abdominal  
Topography



variation. To meet this situation many systems of topographical markings have been advocated. A few of these are illustrated in accompanying figures (Fig. 42). It would, indeed, prove difficult to conceive of any system not already advocated and the many claims and counterclaims relative to the various methods have led to much confusion. A great array of points, lines, circles, triangles, squares, rhomboids, and other figures have been suggested for the surface map, and topography has, in many instances, degenerated from the original high aim of marking upon the surface the location of organs beneath into an attempt to force these organs beneath into imaginary surface compartments, which fail to describe them properly, but prove orderly and convenient to the particular topographical system. The difficulties encountered in attempting to adhere to any single fixed "system" are such that the practical surgeon seems to require some more flexible method for taking his surface measurements and recording his topographical descriptions.

#### The Nine Abdominal Zones

The abdominal wall, by general acceptance, is divided into nine zones:<sup>64</sup> an epigastric, an umbilical, and a hypogastric; a right and a left hypochondriac; a right and a left lumbar; and a right and a left inguinal (Fig. 43). Two transverse and two vertical lines are utilized in bounding these zones. The horizontal lines usually employed are: a subcostal line, passing beneath the lower border of the tenth costal cartilages; and an intertubercular line, determined by the iliac tubercles, which mark the highest point of the iliac crests, and are easily found about 2 inches posterior to the anterior superior iliac spines. The two perpendicular lines (lateral vertical lines) pass upward from points on Poupart's ligaments midway between the symphysis pubis and the anterior superior iliac spines, and are parallel with the median plane of the body.

#### The Transverse Planes

Other transverse planes which have been suggested are illustrated in the accompanying figures (Figs. 43 and 44):

Xiphosternal or xiphoensiform plane

Midepigastric or transpyloric plane

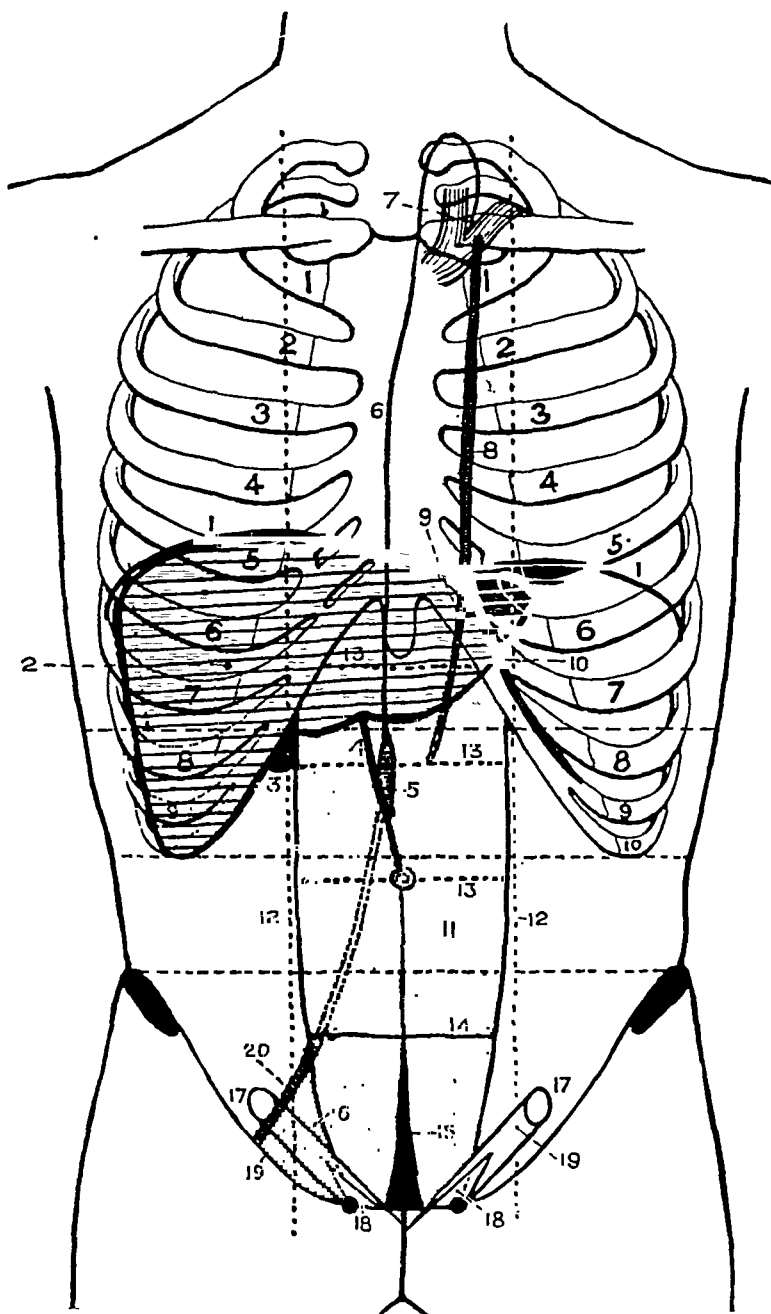


FIG. 43.

1. Diaphragm. 2. Liver. 3. Gall bladder. 4. Ligamentum teres. 5. Receptaculum chyli. 6. Thoracic duct. 7. Venous termination of the duct. 8. Internal mammary artery. 9. Superior epigastric artery. 10. Musculophrenic artery. 11. Rectus abdominis muscle. 12, Linæ semilunares. 13, Linæ transversæ. 14, Semilunar fold of Douglas. 15, Urachus. 16, Hesselbach's triangle. 17, Internal abdominal ring. 18, External abdominal ring. 19, Inguinal canal. 20, Deep epigastric artery. (From Rawling's Landmarks and Surface Markings of the Human Body, Hoeber.)

Subcostal plane  
 Central abdominal plane  
 Umbilical or navel plane

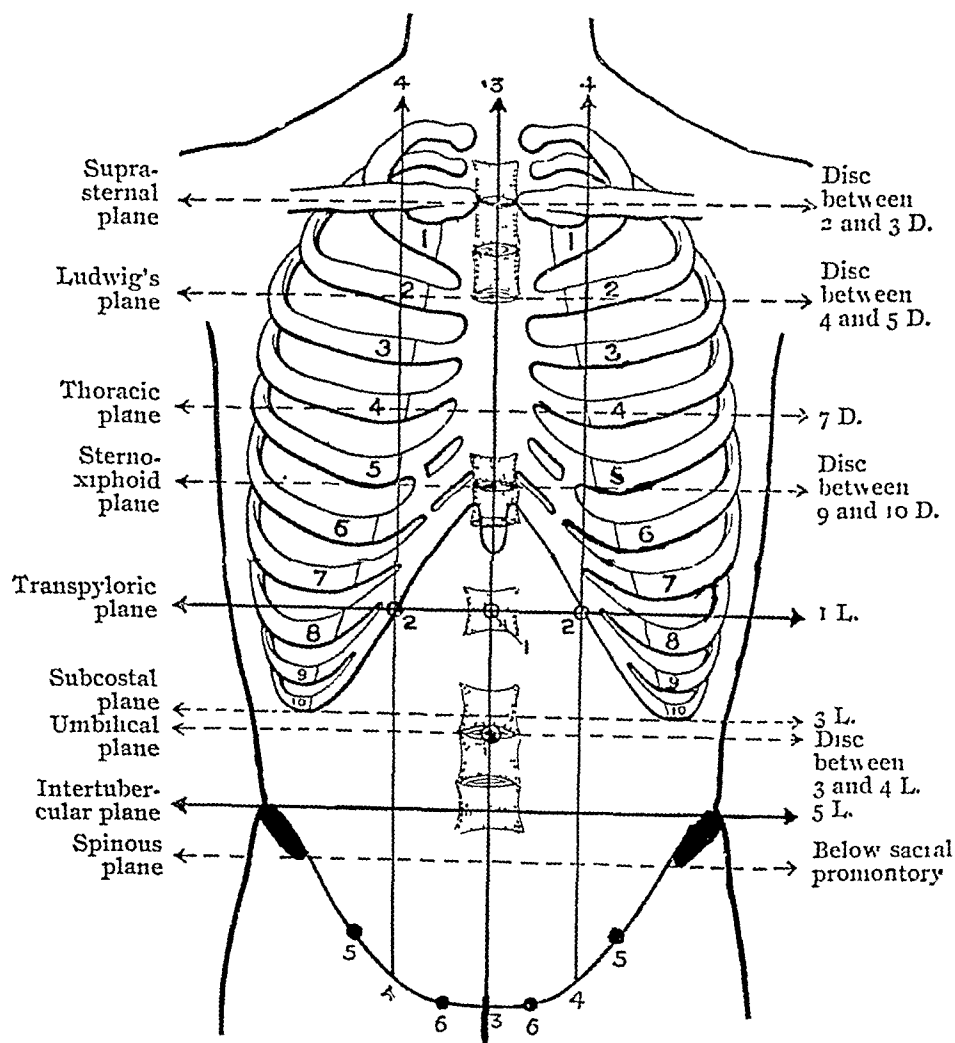


FIG. 44. Chief topographical landmarks of the trunks.

1, Central point. 2, Lateral central or paracentral point. 3, Median vertical plane. 4- Lateral vertical plane. 5, Mid-Poupart point. 6, Pubic spines. (From Rawling's Landmark's and Surface Markings of the Human Body, Hoeber)

Intertubercular plane  
 Interspinous plane  
 Midhypogastric plane and  
 Mid-Poupart plane.

Addison,<sup>65</sup> after taking careful measurements upon forty bodies, was willing to recognize as constant only five of the many surface landmarks of the anterior body wall. These are: (1) The suprasternal notch; (2) upper border of pubes (the symphysis); (3) right anterior superior spine of the ilium; (4) left anterior superior spine of ilium, and (5) the midpoint of the midline of the body. Addison pointed out that planes depending upon points along the costal margins are unreliable and inconstant in position since the thoracic cage is suspended from the spine and is itself variable in location, i.e., that the subcostal plane might fall so low as to coincide with the umbilical or even with the intertubercular plane. He also noted that existing topographical systems failed to include any plane between the levels of the subcostal and the xiphosternal planes, an area of about 6 inches which contained all of the solid organs and many other important structures of the abdomen. By measurements he found that a plane taken at right angles to the midpoint of the trunk was remarkably constant and valuable. This plane has become known as the midepigastric plane, the line of Addison, or the transpyloric plane, and lies opposite the lower border of the first lumbar vertebra. It is determined by taking the midpoint between the suprasternal notch and the symphysis pubis, or again, that midway between the xiphosternal point and the umbilicus. Corresponding as it does with the level of the first lumbar vertebra, Addison's line marks, roughly, the line of dorsal attachment of the transverse mesocolon which separates the abdominal cavity into its two great divisions, the supracolic and the infracolic. This line marks the transverse bisection of the pylorus (normal) when the stomach is at rest, and is in relation not only with the root of the transverse mesocolon, but also with the kidneys, liver, gall bladder, duodenum, stomach, pancreas and spleen. Thus fixed planes (Fig. 45) overlie the first, third, and fifth lumbar vertebrae; uppermost, the midepigastric plane (Addison's line); lowermost, the intertubercular plane; and midway between these, the central abdominal plane which overlies the third vertebral body.

Addison's Line or  
the Midepigastric  
Plane

Among the abdominal “points” (Fig. 46) which have been recorded as being of topographical or clinical value are the following:

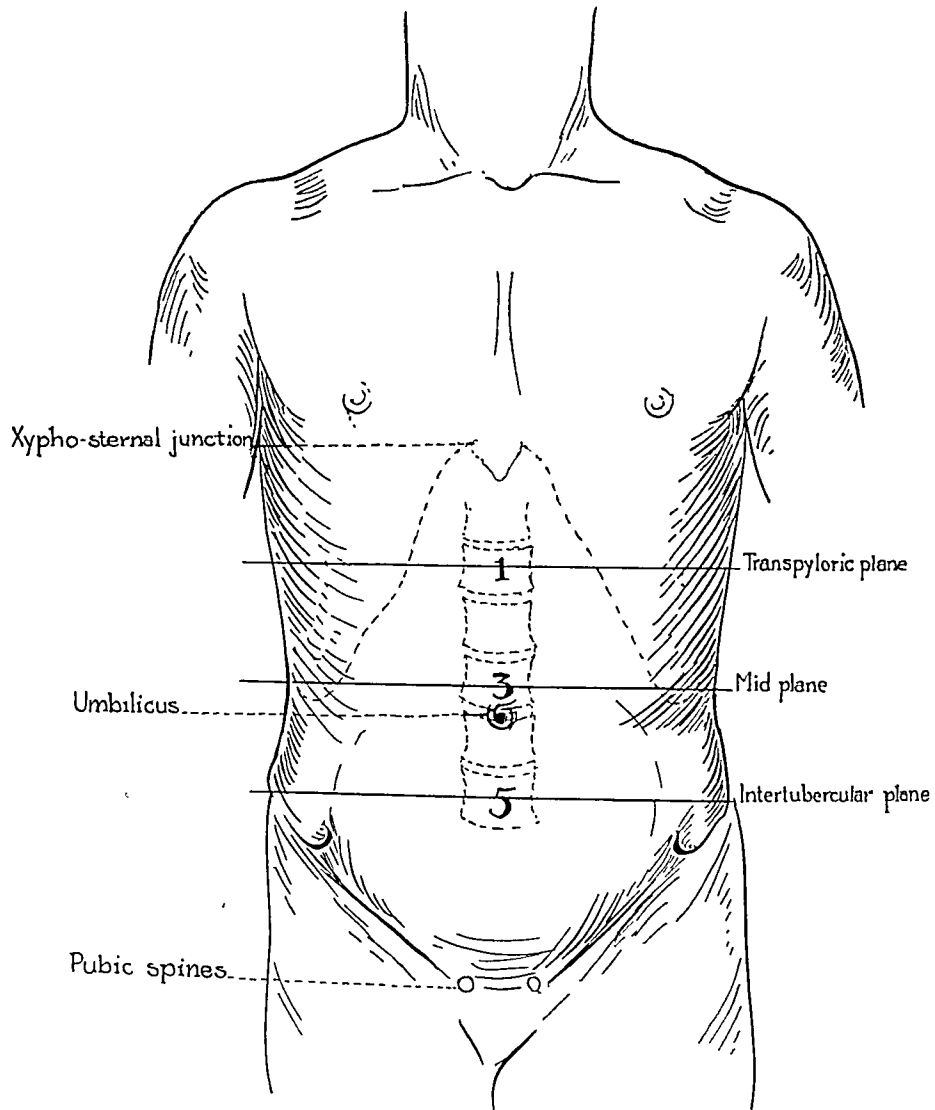


FIG. 45. “Fixed” transverse planes of the abdomen.

*Umbilicus* (definitive name; location discussed).

*Addison's point* (location already given).

*Midepigastrie point* (same as Addison's point).

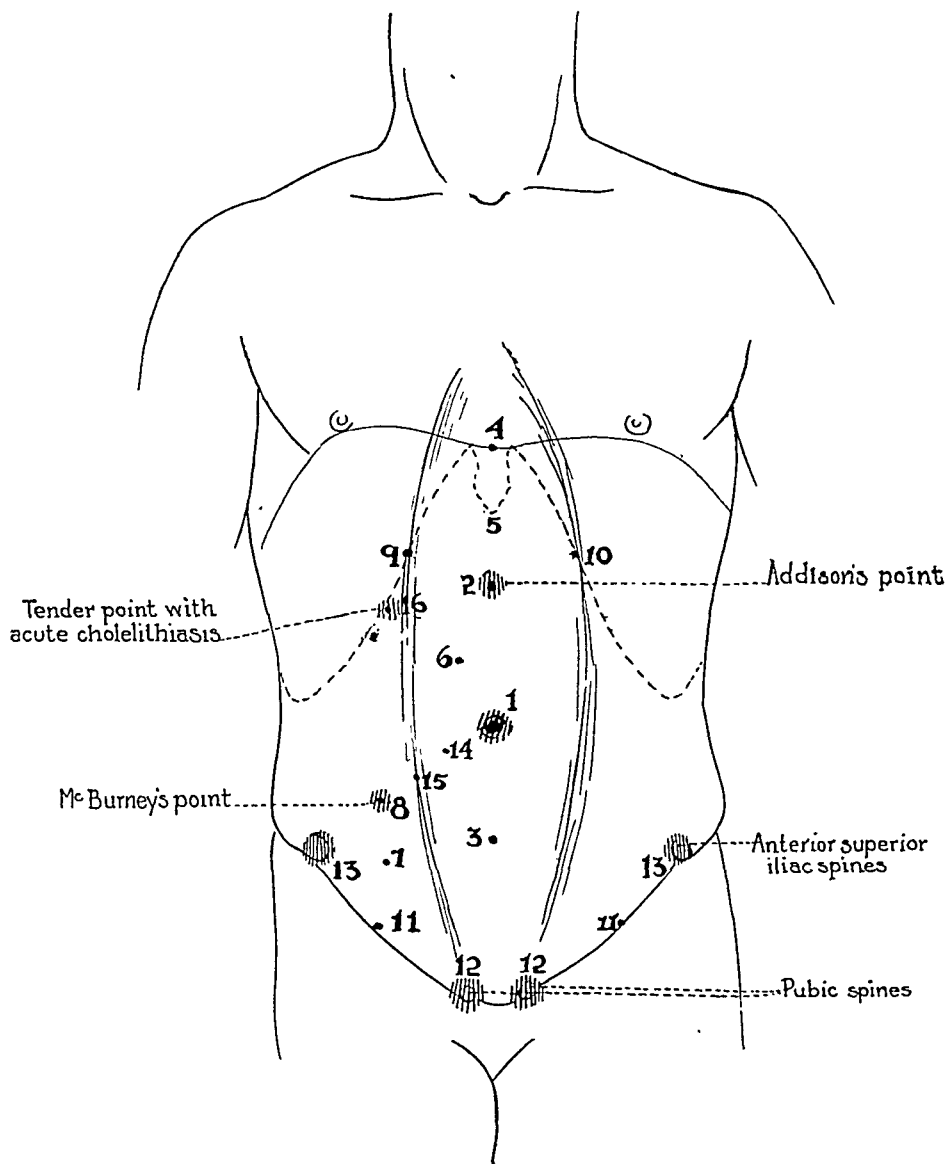


FIG. 46. Abdominal topographical "points."

1, Umbilicus. 2, Addison's or midepigastrie point. 3, Midhypogastric point. 4, Sternoxiphoid point. 5, Tip of ensiform cartilage. 6, Robson's point. 7, Lanz' point. 8, McBurney's point. 9, Right costorectal point. 10, Left costorectal point. 11, Mid-Poupart point. 12, Pubic spine. 13, Anterior superior iliac spine. 14, Morris's point. 15, Munro's point. 16, Tender point with acute cholelithiasis.

"Abdominal  
Points"

*Midhypogastric point*, located halfway between the umbilicus and the symphysis pubis in the linea alba (spinal equivalent is variable).

*Sternoxiphoid point* (definitive name). This lies as a rule on a level with the disc between the ninth and tenth dorsal vertebrae.

*Sternoensiform point* (same as sternoxiphoid point).

*The right costorectal point*, located at the junction of the right linea semilunaris with the costal margin. This anatomical point is supposed to mark approximately the location of the fundus of the gall bladder.

*The left costorectal point* located at the junction of the left linea semilunaris with the costal margin. This marks approximately the spot where the greater curvature of the stomach passes beneath the costal margin.

McBurney's  
Point

*McBurney's point*, described by McBurney<sup>66</sup> as "located between (in different individuals)  $1\frac{1}{2}$  and 2 inches (3 to 5 cm.) of the anterior superior iliac spine on a straight line drawn from that process to the umbilicus." "In every case [of acute appendicitis]," wrote McBurney, "the seat of greatest pain, determined by the pressure of one finger, has been exactly at this point." The point represents the spot at which the terminal filaments of the eleventh thoracic nerve come to the surface as in a whorl (Murphy).

*A diagnostic point for acute diseases of the gall bladder* (Fig. 47). This is located within 1 inch (different directions with different individuals) of the junction of the midepigastria line with the right costal margin.<sup>67</sup> This point marks the site at which the anterior branch of the ninth thoracic nerve comes to the surface in a whorl.

*Robson's point*, located at the inner point of trisection of a line joining the umbilicus and right nipple. Described by Mayo Robson<sup>68</sup> as "just above and to the right of the umbilicus, where tenderness on pressure exists with diseases of the pancreas."

*Munro's point*, at the junction of the spinoumbilical line and the right linea semilunaris.<sup>69</sup> Originally advanced as the

most constant site of the iliocecal valve. It is still retained as a topographical point.

*Morris' point*, located within 2 inches of the umbilicus

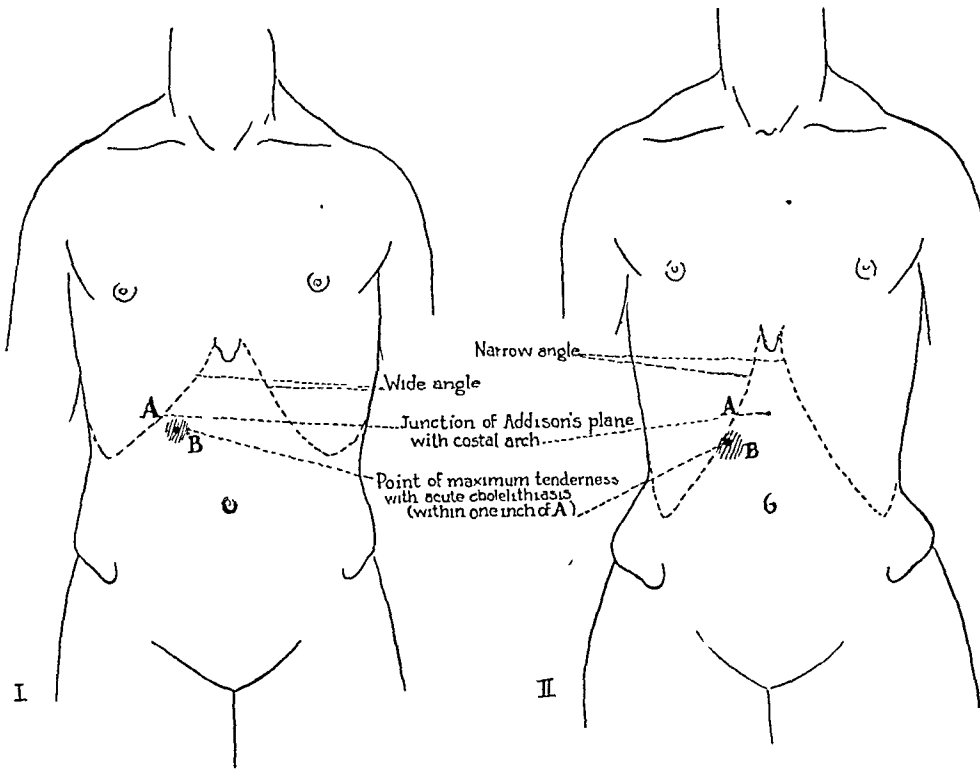


FIG. 47. Tender point for acute cholelithiasis.

- i. With normal or barrel chest.
- ii. With visceroptotic chest.

on the right spinoumbilical line. Believed by Morris<sup>70</sup> to be a site of tenderness with chronic appendicitis, and present when none exists at the site noted with acute appendicitis (i.e., McBurney's point). Much has been said both for and against the value of the sign in the sense proposed by Morris.

*Lanz' point.* This is located at the junction of the right linea semilunaris with the interspinous line, and was proposed as a marking for the usual location of the appendix.<sup>71</sup> While this site possesses no clinical and no distinct anatomical significance; it serves as a topographical landmark.



The value of the points of Munro, Morris and Lanz has been questioned, as has the wisdom in retaining these eponyms. On the other hand, McBurney's point has proved of "inestimable value in the diagnosis of acute appendicitis," and its clinical worth is not in the least modified by the proximity of other surface markings. The analagous point (already described) marking the site of tenderness with acute diseases of the gall bladder seems equally constant and valuable.

Abdominal surgeons make use of several triangles located upon the surface of the anterior, lateral and posterior abdominal wall, and upon the thigh. The list includes:

*Hesselbach's triangle*: base, Poupart's ligament; outer boundary, the deep epigastric artery; inner boundary, linea semilunaris of the same side. This triangle is the site through which direct inguinal hernias protrude.

Surface  
Triangles

*Scarpa's triangle* (femoral or subinguinal triangle): base, Poupart's ligament; inner boundary, adductor longus; outer boundary, the sartorius muscle. It is through the triangle of Scarpa that femoral hernias protrude.

*Petit's triangle* (lumbar triangle or trigone): (Already bounded, see Drainage through the Hepatorenal Pouch).

*Lumbocostoabdominal triangle*: Bounded above, by the last rib; medially, by the lateral border of the sacrospinalis muscle; laterally, by the posterior fibers of the internal oblique; floor, formed by the transversus abdominis; roofed by the serratus posterior inferior muscle. This forms a second point of weakness in the posterolateral abdominal wall.

*Topographical triangles of Hertzler*: This author has described<sup>72</sup> a series of lines radiating from the umbilicus to the following points on each side: the pubic spine, the iliac tubercle, the tip of the eleventh rib, and the nipple, dividing the surface into eight triangles.

*Triangles of cutaneous hyperesthesia*. (These triangles represent a method for the practical use in diagnosis of cutaneous hyperesthesia as initiated by certain visceral disorders.) (See chapter on Visceral Neurology.)

1. *The triangle of renal colic:* base, the inner half of Poupart's ligament; outer boundary, a line parallel to the sartorius muscle, extending from the right mid-Poupart point to the inner margin of the thigh; inner boundary, the inner margin of the thigh from the apex of the triangle to the right pubic spine.<sup>76</sup>

The Appendiceal;  
Ureteral and  
Biliary Triangles

2. *The triangle of biliary colic.* Base, the linea alba from the sternoxiphoid point to the umbilicus; upper boundary, a line from the sternoxiphoid point to the junction of the mid-epigastric plane (Addison's line), with the right midaxillary line; lower boundary, a line from this point (junction of Addison's line and the midaxillary line) to the umbilicus.<sup>73</sup>

3. *The triangle of acute appendicitis.* Base, a line from the umbilicus to the right pubic spine; lower boundary, a line from the pubic spine to the right iliac tubercle; upper boundary, a line from the right iliac tubercle to the umbilicus.<sup>74</sup>

The surgeon in recording the exact location of tumors and other abnormalities may exercise great freedom and latitude as to topographical method. He is able to accept the advantages of any or all of the fixed systems based upon the authority of individual anatomists, but at the same time need not be hampered by the limitations of any single system. This is true because the surgeon is not seeking, as is the anatomist, surface lines or areas bearing precise relationships to underlying structures constant in location, but is dealing with masses which may appear at any point whatsoever. The common denominator of all topographical systems is their surface landmarks, and by going back to these, the surgeon attains the flexibility which his work demands. He is able at will to strike lines, mark out circles, subtend angles, and create planes, so long as he works from clearly understood landmarks. Moreover, in dealing repeatedly with an individual patient, whose abdominal landmarks will remain approximately the same at different examinations, the surgeon is not limited to the relatively few points or planes which are so exactly fixed as to be universally applicable, hence

A Flexible System  
of Topography

serviceable for the anatomist. In this flexible method any landmark may be utilized. In adopting the method, certain useful rules may be stated:

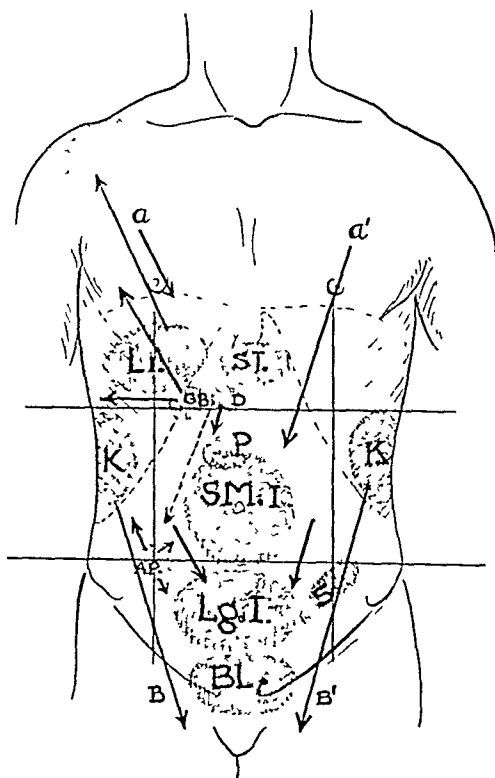


FIG. 48.

FIG. 48. Common sites of pain and pain-radiation with acute abdominal disorders.

St, Stomach. D, Duodenum. P, Pancreas. Sm. I, Small intestine. Lg. I., Large intestine. Bl., Bladder. K., Kidney and ureter. S, Sigmoid colon. G.B., Gall bladder. A-A', Pain of thoracic disease referred to abdomen. B-B', Pain of uterine colic referred to thigh and genitals.

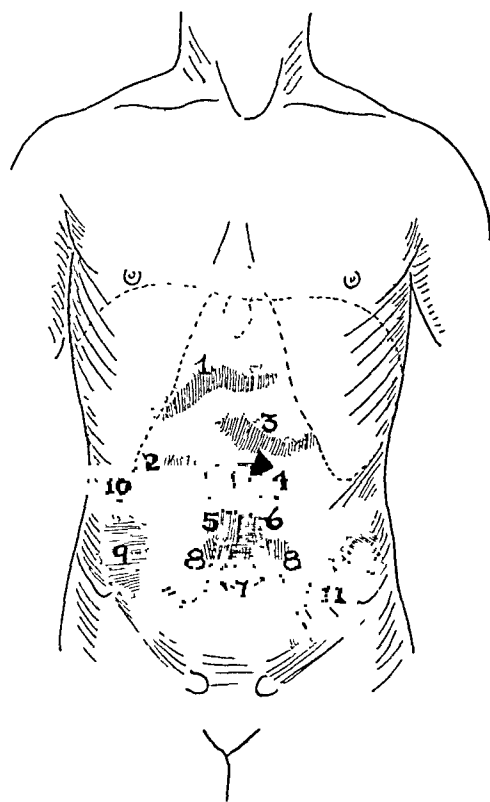


FIG. 49.

FIG. 49. Abdominal organs most often felt during abdominal examination. (Modified from Elsberg.)

1, Margin of liver. 2, Transverse colon. 3, Greater curvature of stomach. 4, Transverse colon. 5, Lumbar vertebrae. 6, Aorta. 7, Iliac arteries (common). 8, Psoas major muscle. 9, Cecum and ascending colon. 10, Lower pole of right kidney. 11, Sigmoid and descending colon.

*To create a topographical point:* (a) Create two lines which meet at this point (example, the rectocostal point is located at the junction of the outer border of the right rectus sheath

with the costal margin. (b) Pass any line which can be determined by two landmarks through the point and measure along this line to the desired point from either landmark (example, McBurney's point is located from  $1\frac{1}{2}$  to 2 inches along the spinoumbilical line).

*To create a topographical line:* Take the shortest distance between two topographical points.

*To create a topographical circle:* Take an imaginary circle having a stated radius from any fixed topographical point.

*To create a topographical triangle:* Join three landmarks, so selected that the boundaries of the triangle (lines joining the landmarks) roughly bound the abnormality in question.

*To enclose any topographical figure:* Consecutively join any set of landmarks, so selected that the joining lines enclose the abnormality to be described.

*Examples of application of flexible method:*

1. "This globular, cystic mass lies within a circle having a 2 inch radius and a center 1 inch to the right of the umbilicus" (case proved to be one of mesenteric cyst).

2. "This sausage-shaped mass is 2 inches wide and extends horizontally, lateral to the right mid-Poupart line, from a point 1 inch below the level of the anterior superior iliac spine, to end indefinitely at about 1 inch below the right costal margin" (this case proved to be one of iliocecal tuberculosis).

3. "This pear-shaped mass extends downward for  $2\frac{1}{2}$  inches from the right rectocostal point. It can be moved to the right for 2 inches and to the left as far as the midline, describing an arc the concavity of which is directed upward, the obvious point of attachment of the mass being within the right hypochondrium" (case proved to be one of hydrops of the gall bladder).

The accompanying clinical illustrations (Figs. 48, 49) are self-explanatory. They demonstrate with reference to topography, (a) the normal intra-abdominal structures which may most often be palpated through the anterior abdominal wall (Fig. 48); and (b) the usual sites and radiations of certain common abdominal pains (Fig. 49).

## EPONYM

## CHARLES MCBURNEY

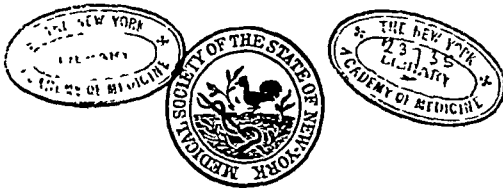
- Eponym:** "McBurney's Point."  
**Nativity:** Roxbury, Massachusetts.  
**Birth and Death:** Born February 17, 1845. Died November 7, 1913.  
**Connections:** 1873. Assistant demonstrator of anatomy at the College of Physicians and Surgeons.  
 1874. Attending surgeon, St. Luke's Hospital.  
 1880. Assistant surgeon, Bellevue Hospital.  
 1882. Lecturer on operative surgery, College of Physicians and Surgeons.  
 1886. Consulting surgeon to Presbyterian Hospital; New York Hospital; Hospital for the Ruptured and Crippled.  
 1888. Given entire surgical service of Roosevelt Hospital. (Held position for twelve years.)  
 1889. Professor of surgery, College of Physicians and Surgeons.  
 1892-1895. Vice-president, New York Academy of Medicine. Honorary member of the Royal College of Surgeons (England). Honorary Member of College of Physicians and Surgeons (Phila.).
- Education:** Early education; private schools of Boston.  
 Bachelor of Arts, Harvard, 1866.  
 Medical degree, College of Physicians and Surgeons, 1870.  
 Surgical internship, Bellevue Hospital, New York City.  
 Postgraduate study (Europe) subsequent two years.
- Eponym Source:** "Experience with Early Operative Interference in Cases of Disease of the Vermiform Appendix," *New York M. J.*, 50: 676, 1889.  
 "Discussion on Appendicitis; Indications for Early Laparotomy." *Tr. M. Soc. N. Y.*, 1891, p. 208.
- Other Writings:** McBurney also wrote concerning the transduodenal method for removing stones from the common bile duct; about "a small transperitoneal incision for the purpose of compression of the common iliac artery by the fingers of an assistant during disarticulation of the hip joint;" contributed to Dennis' System of Surgery, also to the International Textbook of Surgery. He introduced McBurney's hooks for skin grafting and McBurney's tractor for the reduction of fractures at the shoulder joint. It was in 1894 that he proposed the so-called McBurney incision for appendectomy.
- Discussion of Eponym:** McBurney stated that his point indicated the most common site of the base of the appendix. This started a wave of anatomical investigation as to the accuracy of the statement. Notable among the opponents of McBurney were Munro and Lanz. The former found the base of the appendix most often beneath the junction of the spino-umbilical line with the right linea semilunaris (Munro's point);<sup>1</sup> the latter stated that the base of the appendix most often was to be found at the junction of the outer and midthirds of the interspinous line (Lanz' point).<sup>2</sup>
- Treves was particularly outspoken as to the variation in the position of the appendix and gave little recognition to the value of the single point of McBurney.<sup>3</sup>
- Murphy, while recognizing the error in assuming that McBurney's point overlay the site of the base of the appendix was still emphatic as to the clinical value of the point-tenderness sign and extensively reviewed possible explanations as to the constancy of the diagnostic evidence.<sup>4</sup> Among suggested interpretations were, a, that the point was due to an excitation by pressure, of underlying sympathetic ganglia b, that it originated

# TRANSACTIONS

# MEDICAL SOCIETY

OF THE  
STATE OF NEW YORK,

FOR THE YEAR 1891.



PUBLISHED BY THE SOCIETY.  
1891.

FIG. 50A. Title page of the *Transactions of the Medical Society of the State of New York*, 1891, and the page on which McBurney's discussion of appendicitis appeared.

## XVI. DISCUSSION ON APPENDICITIS: THE INDICATIONS FOR EARLY LAPAROTOMY.

By CHARLES MCBURNEY, M.D.,  
NEW YORK.

THE title of this paper is one which a very few years ago—not more than four—would have excited the surprise and even the condemnation of many surgical and medical practitioners. The very

I have found the *exact* locality where the greatest sensitiveness to pressure exists to be a valuable means of diagnosis, so that in every case of abdominal pain, not otherwise satisfactorily explained, I make a careful search for it. In the first hours of an attack of appendicitis, it is not enough to compress with the whole hand the region of the iliac fossa. Such pressure will often elicit no more complaint from the patient than pressure of a similar kind made at other parts of the abdomen. But if firm pressure is made with the finger-tip, and especially if the patient be made to cough while such pressure is being exerted, it is invariably easy to determine that the most sensitive point is a definite one in most cases. This point is very accurately in the adult from one and a half to two inches inside of the right anterior superior spinous process of the ilium on a line drawn to the umbilicus. In children it is, in proportion to their size, so much less distant from the spinous process. Occasionally this most sensitive spot will be found a half inch or so nearer the pubes, and sometimes this sensitive area will be larger than usual, but from the first hours of the disease, even up to the end of several days, this sign may be clearly made out in every case. No other acute disease presents this feature. The accuracy of this sign I have demonstrated in every case operated upon by me since I first made the observation. The point described corresponds very accurately in the living subject to the base of the appendix, and for this reason the sign is clearly defined, whether the appendix is long or short, or points up or down. Of course, in late stages of the disease this sign does not usually exist. My friend, Dr. Weir (*The Medical News*, March 1, 1890), commenting upon this observation of mine as to the exact spot of extremest sensitiveness on finger-tip pressure, does not agree with me as to its value, and says: "Furthermore, I have myself found on examination of 18 healthy persons by the above test of McBurney, that in 4 of them decided

*Continued from p. 124*

from inflamed lymph nodes at this site, c, that the tenderness came from a lymphangitis originating from the appendix and spreading to this area. Murphy believed the real explanation to be that the point of McBurney represented a local area of distribution of cutaneous and subcutaneous nerves which were in reflex connection with afferent stimuli arising from the appendix; he held that the spot indicated by McBurney was that of maximum tenderness regardless of the position of the appendix itself and that the tenderness arose from pressure upon the structures of the body wall itself, not upon structures within the peritoneal cavity beneath.

Many incorrect statements as to the location of McBurney's point are to be found in current surgical textbooks and dictionaries. The most common misstatement is that the point lies half way between the right anterior superior iliac spine and the umbilicus.<sup>5,6,7,8</sup> It may also be read that the point is always 5 cm.; also 7 cm. from the iliac spine; that it corresponds to the outer margin of the rectus abdominis muscle on the spinoumbilical line, etc.

The fact seems generally to have been ignored that McBurney did not say there was one exact point of maximum tenderness applicable to all individuals but stated that the location of the point was at a variable distance along the spinoumbilical line (within two inches of the anterior superior iliac spine) i.e., while there is no single exact point for all individuals, for *each* individual there is such a single exact point and its location is between one-and-a-half and two inches of the right anterior superior iliac spine on the spino-umbilical line.

#### Points of Interest:

McBurney was a true sportsman being always fond of outdoor life; during his internship at Bellevue he rowed almost daily upon the East River in a single shell; he was an ardent devotee to golf; was an expert shot and an expert salmon fisherman.

McBurney was among the first to adopt, improve, and simplify aseptic methods such as sterilization of operating materials and instruments by means of the modern steam sterilizer and the use of sterilized gloves in operative work. His fame rests largely with his treatment of appendicitis by the operative method.

By a gift of William J. Sims (1892) the first model elaborate operating pavilion was established for McBurney at Roosevelt Hospital. "His workshop, the Sim's amphitheater of the Roosevelt Hospital was planned by him and built under his direction and was at the time one of the finest surgical amphitheaters in America and a Mecca for American as well as Foreign surgeons."

"He could not have been called a brilliant operator but his lack of hesitation founded on care with which he planned every operation and the thoroughness with which he completed each step before passing to the next resulted in a great saving of time and left the spectator with a profound impression that he had seen a master of art at work; bold, yet a great respecter of tissues, the finished result of his operation left little to be desired" (Peck).

McBurney married Mary Willoughby Weston, Oct. 8, 1874. They had two sons and a daughter. Mrs. McBurney died in 1909.

Dr. McBurney was called to the bedside of President McKinley a few days before his (McKinley's) death.

Due to ill health McBurney retired in 1908 and died at the home of his sister in Brookline, Mass. of heart failure following a hunting trip in Maine (Nov. 7, 1913).

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SUPPLEMENT: A. J. S., n. s. Vol. VIII, No. 3, p. 730

Original Communications.

EXPERIENCE WITH  
EARLY OPERATIVE INTERFERENCE IN CASES OF  
DISEASE OF THE VERMIFORM APPENDIX.\*

By CHARLES MCBURNEY, M.D.,  
VISITING SURGEON TO THE ROOSEVELT HOSPITAL.

I VENTURE to introduce once more a subject that has been so ably treated by numerous writers, because I have for some time been devoting my attention in suitable cases to a particular line of treatment, and because I have been fortunate enough to have had recently a considerable number of cases of disease of the appendix under my care.

It is not my intention in this paper to attempt to present the subject of pericecal inflammations in a systematic manner. That has already been done, and very recently, by a large number of writers. I have chosen rather to dwell upon some points in the pathology and treatment of these inflammations, which are beginning to be better understood and which especially interest us all. The fact that inflammatory affections of the vermiform appendix give rise to a considerable number of the so-called pericecal inflammations is now accepted in every part of the medical and surgical world.

This is, I believe, the first recorded case where an acutely inflamed unruptured appendix has been removed full of pus. Who can doubt what the result would have been in this particular case had the cyst ruptured, and the operation been delayed a few hours? Would not the opportunity for recovery have been lost had the advice so often and so recently given been followed—to delay operation until symptoms of spreading peritonitis appeared?

\* Read before the New York Surgical Society, November 13, 1889.

The exact locality of the greatest sensitiveness to pressure has seemed to me to be usually one of importance. Whatever may be the position of the healthy appendix as found in the dead-house—and I am well aware that its position when uninflamed varies greatly—I have found in all of my operations that it lay, either thickened, shortened, or adherent, very close to its point of attachment to the cæcum. This, of course, must, in early stages of the disease, determine the seat of greatest pain on pressure. And I believe that in every case the seat of greatest pain, determined by the pressure of one finger, has been very exactly between an inch and a half and two inches from the anterior spinous process of the ilium on a straight line drawn from that process to the umbilicus. This may appear to be an affection of accuracy, but, so far as my experience goes, the observation is correct.\*

Before describing the steps of the operation, I refer again to the important aid to diagnosis of which I have already spoken—namely, the ascertaining, by the pressure of a single finger-tip, that the point of greatest tenderness is, in the average adult, almost exactly two inches from the anterior iliac spine, on a line drawn from this process through the umbilicus. Much greater tenderness at this point than at others, taken in connection with the history of the case and the other well-known signs, I look upon as almost pathognomonic of appendicitis. This point indicates the situation of the base of the appendix, where it arises from the cæcum, but does not by any means demonstrate, as one might conclude, that the chief point of disease is there. The abscess, or concretion, or cyst may be at quite a little distance, but the greatest pain, on pressure with one finger, will be felt at the point described.

\* Since reading this paper I have carefully observed three other cases. In two the point of pain shown by pressure with one finger was two inches, and in the other an inch and seven eighths from the anterior spine.

FIG. 50B. Excerpts from McBurney's article in *The New York Medical Journal*.



## EPONYM

## JOHANN FRIEDRICH MECKEL

- Eponym:** Meckel's diverticulum. (Remains of the ompholoenteric duct.)
- Nativity:** Halle, Germany.
- Birth; Death:** Born Oct. 17, 1781. Died, Oct. 31, 1833.
- Connections:** Appointed professor of surgery at Halle but promptly exchanged this chair for that of professor of anatomy and physiology.
- Education:** Early education received under his paternal roof. Sent to Magdeburg where he attended the city school.  
Studied medicine at Halle and at Göttingen.  
Thesis at University of Halle, at the age of twenty-one, "De Conditionibus Cordis Abnormibus."
- Eponym Source:** Received his doctor's degree at Halle in 1802.  
Traveled in Italy, Germany, and France where he studied comparative anatomy. (Recalled from his first trip to Vienna by the death of his father 1803.)  
"Ueber die Divertikel am Darmkanal." *Arch. f. Physiol.*, 9:421-453, 1809.  
Biographie universelle; ancienne et moderne, 27:459.  
Manual of Descriptive and Pathological Anatomy. English Ed. London, E. Henderson, 1838.  
(Translated to English from the French by A. S. Doane.)  
(Translated to French from the German by Jourdan & Breshet.)  
(Original German edition was published in 1812.)
- Other Writings:** Abhandlungen aus der Menschlichen und Vergleichender Anatomie und Physiologie. Halle, Hemmerde u. Schwetschke, 1806.  
Handbuch der Menschlichen Anatomie Halle u. Berlin 1811.  
Editor, Deutsches Archiv. für die Physiologie. Halle u. Berlin 1815-1823.  
Editor, Archiv. für Anatomie und Physiologie. Leipzig 1826-1832.
- Discussion of Eponym:** Considerable confusion has arisen regarding credit for this eponym due to the fact that there were two anatomists, grandfather and grandson, with identical names. By many (Stedman,<sup>1</sup> Buck,<sup>2</sup> Buntz,<sup>3</sup> and others<sup>4</sup>) credit has been given to Johann Friedrich Meckel, the elder (1717-1774) but the writings of this anatomist fails to show that he studied or described the diverticulum in question.  
The elder Meckel is rightly known for Meckel's ganglion (spheno-palatine); Meckel's cavity (space enclosing the Gasserian ganglion); Meckel's band (portion of anterior ligament binding the malleus to the wall of the tympanic) etc. He also wrote concerning hernias (Tractatus de Morbo Hernioso Congenito Singulari et Complicato Feliciter Curato. Berloini, F. Nicolai, 1772), but included no reference to diverticulum of the terminal ileum.  
It was the grandson, Johann Freidrich Meckel, the younger, who wrote extensively concerning the omphalo-mesenteric duct and who distinguished the diverticulum arising from this duct from all other diverticuli of the enteric tract. The younger Meckel described the relation of the omphalo-mesenteric vessels to the diverticulum and the passage of vascular cords from the mesentery of the small bowel to the umbilicus. The diverticulum, however, had been previously described and in 1809 Meckel collected all recorded cases to that date (Ueber Diverticuli; see photostat). Among these few cases were two recorded by his father (Philipp Freidrich Theodor Meckel, 1753-1803) (Thamm de Genitalium sex. Varietatibus. Halae, 1799. Pg. 27, see photostat).  
The first reference by a Meckel, then, to a diverticulum of the terminal ilium seems to have been made by Philipp Freidrich Theodor Meckel but it was Johann Freidrich

## Archiv für die Physiologie.

Neunten Bandes drittes Heft.

Ueber die Divertikel am Darmkanal,  
vom Prof. Meckel.

Gegen diese Gründe und Beyspiele aber könnte man einwenden, daß sie nichts für den normalen Bau beweisen, indem sie von Mißgeburten entlehnt seyen; allein dieser Einwurf hebt sich durch die Untersuchung menschlicher Embryonen sehr leicht. Schon früher \*) habe ich einen Fötus beschrieben, bey dem aus dem Vereinigungswinkel des obern und untern Dünndarmstückes sich ein von den Nabelgefäßen verschiedenes, gelbliches Gefäß in der Nabelscheide fortbegab. Bey einem andern, noch frühern Fötus \*\*), sah ich ein ähnliches Gefäß von der Nabelblase aus durch den ganzen Nabelstrang verlaufen. Kürzlich habe ich in derselben Hinsicht noch einige Embryonen untersucht, und bey spätern, ungefähr zehn Wochen alten, zwar den Darmkanal in den Unterleib zurückgezogen, jenen langen Kanal, so wie die Nabelblase selbst, verschwunden, aber dafür bey zwey Embryonen dieses Alters, an der gewohnten Stelle, ungefähr einen Zoll über der Verbindung des Grimmdarms mit dem Krummdarme, aufser dem deutlichen Blinddarm ein wahres blindes Divertikel, das bey dem einen eine halbe, bey dem andern eine ganze Linie lang war, dort perpendikulär, hier schief auf dem Krummdarm stand, und nur halb so weit, als er selbst war, angetroffen. In beiden waren zugleich die Gekrösnabelgefäße als äußerst feine, dünne Fäden gegenwärtig, in beiden lagen die Darmanhänge dem Nabel gegenüber.

\*) Beiträge zur vergl. und menschl. Anat. H. J. S. 82.

\*\*) Ebend. S. 92.

51A. Meckel's description of the diverticulum called after him, and title page of the number of *Archiv für die Physiologie* in which it appeared. Translation:

### Diverticuli of the Gastrointestinal Tract.

"We might reject these reasons and examples as not proving the case of normal structures, since they describe monsters. Yet this objection is easily overcome by the study of human embryos. Recently I described a fetus (*Studies in Comparative and Human Anatomy*, 11:81) exhibiting a yellowish vessel differing from the umbilical vessels arising from the angle of junction between the upper and lower portions of the

[129]

# ARCHIV FÜR DIE PHYSIOLOGIE

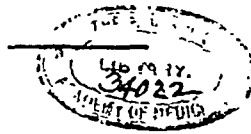
VON DEN

PROFESSOREN

D. JOH. CHRIST. REIL

UND

D. J. H. F. AUTENRIETH.



NEUNTER BAND.

MIT FÜNF SUPPLEMENTEN.

HALLE

IN DER CURTSCHEN BUCHHANDLUNG  
1892.

Mein Vater \*) fand sie einmal mit Halsenscharte, Gaumenspalte und doppelter Gebärmutter, und sah mit denselben Mißbildungen in einem andern Falle zwar kein Divertikel des Darmanhangs, aber doch eine andere abweichende Bildung, welche deutlich dasselbe ausdrückte, nemlich die vasa omphalo-mesenterica, die von der obern Gekröspulsader sich zum Nabel erstreckten \*\*).

\*) *Thesaurus de genitalium sex. seq. varietatibus*, Halae 1799. p. 27.

\*\*) Ebend. S. 29.

Meckel the younger who wrote repeatedly and voluminously upon this subject and who devoted many years of study to this anatomical abnormality, hence to whom this eponymic honor chiefly belongs.

This remarkable family of Prussian anatomists included not only father, son, and grandson, but the younger Meckel had also a brother (August Albrecht Meckel, 1790-1829) who became professor of anatomy and forensic medicine at Bern in 1821.

The hobby of the Meckels was a magnificent anatomical museum which was founded by the grandfather, enriched by the father, and enlarged and maintained by the grandson.

Johann Freidrich the younger spent all of his vacations in scientific trips to the principal cities of Europe gathering materials for the museum:

To Italy in 1806, returning by foot all the distance from Florence to Halle.

To Naples in 1811, accompanied by his brother.

To Netherlands, England, and France in 1818.

To Vienna in 1819.

To Paris and Cette in 1821.

To Sicily and Italy in 1824; to Salzburg in 1828; to Venice and Trieste in 1831.

Meckel married in 1810 and his wife was his constant companion in his travels and studies.

When his father (Philipp) who was a highly honored obstetrician as well as an anatomist, was called to the Russian court at St. Petersburg to deliver Empress Marie, the younger Meckel accompanied him.

Meckel died at the age of 52 (1833) from "abdominal hydropsy," having suffered for years from an affection of the liver.

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*Continued from p. 129*

small intestine and continuing into the umbilical sheath. In another still younger fetus I found a similar vessel continuing from the umbilical vesicle throughout the length of the umbilical cord. With this in mind I recently studied a few more embryos and found in older, about ten weeks old, embryos that the intestinal canal had returned to the abdomen and the above long canal as well as the umbilical vesicle had disappeared; but in another I found two embryos of this age (ten weeks) at the usual spot, about one inch above the junction of the colon with the ileum, beside the true appendix a real blind diverticulum, in one fetus it was half a line, in the other one line long; in the first it was placed perpendicularly, in the second, obliquely to the ileum and was only half as wide as the latter. In both embryos the omphalomesenteric vessels were present as fine filaments and in both these diverticuli were found right opposite the umbilicus.

My father found it [diverticulum] associated in one case with hare-lip, cleft palate, and duplex uterus; and found these same abnormalities associated in another case, not with a diverticulum of the intestinal appendage, yet with another malformation which distinctly represented the same abnormality; the *vas omphalo-mesenterica* which extended from the upper mesenteric artery to the umbilicus."

SUPPLEMENT: A. J. S., n. s. Vol. VIII, No. 3, p. 734

MANUAL  
OF  
DESCRIPTIVE  
AND  
PATHOLOGICAL ANATOMY,

BY  
J. F. MECKEL,

Professor of Anatomy at Halle, &c. &c. &c.

TRANSLATED FROM THE GERMAN INTO FRENCH,  
WITH ADDITIONS AND NOTES,

BY

A. J. L. JOURDAN,

Member of the Royal Academy of Medicine at Paris, &c. &c. &c.

AND

G. BRESCHET,

Adjunct Professor of Anatomy at the School of Medicine, &c. &c. &c.

TRANSLATED FROM THE FRENCH,

WITH NOTES,

BY A. S. DOANE, A.M., M.D.,

AND OTHERS.

IN TWO VOLUMES. FEB 28 1893

VOL. II.

LONDON: 75093

E. HENDERSON, OLD BAILEY.

FANNY AND CO., DUBLIN, CARPMAK AND SON, EDINBURGH.

1838.

B. DIFFERENCES DEPENDING ON DEVELOPMENT.

§ 2185. Of all the parts in the abdominal cavity the intestinal canal is formed first; its mode of development and the changes in its situation, form, and volume, present equally remarkable phenomena.\*

A. MODE OF DEVELOPMENT.

§ 2186. In respect to the mode of development one part is most intimately connected with the formation of the whole foetus, but particularly with that of the intestinal canal, and most consequently be mentioned first. We mean the umbilical vesicle (*vesicula intestinalis*, a *umbilicalis*). It is a small, more or less rounded pouch, situated between the chorion and the amnion, and is probably much larger in proportion to the foetus the more recent the period of conception. It is even greater than the foetus during the early periods of gestation, and we have reason to think that it is always formed before it. It extends first to the anterior face of the body of the foetus, which rests directly upon it. But gradually and even early in the first month of gestation, it diminishes much, and is situated farther from the

OF THE DIGESTIVE SYSTEM.

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foetus, so that in the second month it is on the outside of the umbilical cord.

Do the parietes of the umbilical vesicle and the intestinal canal primitively communicate? Several anatomists of great merit think that this communication is demonstrated neither in the foetuses of the mammalia generally nor in that of man in particular. The following facts, however, render this opinion very probable:

1st. The analogy with birds, reptiles, and cartilaginous fishes, to the vitelline membrane of which the umbilical vesicle corresponds perfectly, and in which it is proved that the communication in dispute exists at all periods of fetal existence.

2nd. We sometimes perceive in very young foetuses a canal which goes across the umbilical sheath, from the vesicle to the abdomen, and by which we can at pleasure empty the vesicle of this fluid, and fill it again.

3rd. We always find in the foetus, until the commencement of the fourth month, blood vessels which go from the mesentery to the umbilical vesicle, unite first on this latter, but gradually extend only to the anterior wall of the abdomen, and finally die, and are ruptured or entirely effaced. These are the *omphalo-mesenteric* vessels (*vasa omphalo-mesenterica*), comprehending an artery and a vein, which arise from the mesenteric vessels.

These vessels also exist in birds, where they go to the yolk, proceeding along the vitelline canal.

4th. The intestines are at first very near the umbilical vesicle, and are situated out of the abdomen in the umbilical sheath, which at this period really makes part of the abdominal cavity.

It is not unfrequent, proportionally speaking, to find in the full grown foetus a canal which extends from the intestine to the umbilicus, which opens in this latter place, and is always attended by the *omphalo-mesenteric* vessels.

It is then very probable, though not certain, from all these facts, that the umbilical vesicle and the intestinal canal originally communicate. There are, however, others which really demonstrate the existence of this communication.

Thus we have mentioned above a human foetus five lines long, in which we saw distinctly a filament attached to the umbilical vesicle and extended to the intestine, and we have figured this communication as it exists in foetuses of sheep and cows, since admitted by Bojanus also in the foetuses of sheep.

\* Emmert—Hueschleitter—Cuvier, *Ann. du Muséum*, vol. III.  
† Needham, *De form. fetu*, London, 1667, p. 79.—Bismenbach, *Spec. anat. cynos. internum col. uter. et cl. ut.*, Göttingen, 1720, p. 11.—Bismenbach, in Haller, *Grundriss der Physiologie*, vol. II, p. 759, 800.

‡ Hunter, *Anatomische Beschreibung der Leber*, Uterus, p. 66.  
§ Meckel, *Handbuch der pathologischen Anatomie*, vol. I, p. 562.—We have also verified this remark in at least ten foetuses of this age.

¶ Meckel, *Abhandlungen*, 1806, p. 301.—Oken, *Brutzeuge*, 1846, ch. ix.  
‡ We have collected, in the first volume of our *Hand der Path. Anatomie*, all the known cases of this anomaly, one of which we observed and described (*Med. Archiv. für die Physiologie*, vol. 12).

§ 2187. Does the intestinal canal always communicate with the umbilical vesicle in one determinate point? What is this point?

First, this canal is continuous with the vesicle by its anterior edge, but very probably the point to which the communication is finally confined, always corresponds to a determinate place, although it may vary in a certain extent.

This place is in the small intestine, and nearer its lower than its upper extremity.

Very probably, there is a period in the existence of the human foetus, when a similar small tubercle exists regularly, after the umbilical vesicle is separated from the intestine. Having found a very large diverticulum attended by the *omphalo-mesenteric* vessels in four human foetuses three months old, which we had occasion to examine at nearly the same time, we have reason to think that the appendix continues regularly until this period, that is, long after the intestinal canal has entered the abdomen. But we now renounce this opinion, although it has been refuted by no one. If a diverticulum really exist for some time as a normal formation, it disappears long before the end of the third month of gestation, since we have seen the cecum in the seventh week, although there was no trace of a diverticulum; whence it follows, that the *omphalo-mesenteric* vessels continue much longer than it. But this circumstance does not prove that the diverticulum never exists normally, or that Oken's opinion of the cecum is correct.

FIG. 51B. Title page and excerpts from English translation of Meckel's book.

## EPONYM

## SIR CHRISTOPHER ADDISON

- Eponym: Addison's point. (Midepigastic point.)  
 Addison's line. (Transpyloric plane.)  
 Nativity: Hogsthorp, Lincolnshire, England.  
 Birth: Born, June 19, 1869. Living anatomist.  
 Source of Eponym: "On the Topographical Anatomy of the Abdominal Viscera in Man." *J. Anat. & Physiol.*, 33 (N. S., 13): 567, 1899.

## THE

## JOURNAL

OF

## ANATOMY AND PHYSIOLOGY

NORMAL AND PATHOLOGICAL,  
HUMAN AND COMPARATIVE

## CONDUCTED BY

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 PROFESSOR OF ANATOMY AND CHIEF CLINIC IN THE UNIVERSITY OF DUBLIN;

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VOL. XXXIII.

NEW SERIES.—VOLUME XIII.

WITH XLVI. PLATES AND NUMEROUS ILLUSTRATIONS IN TEXT.

INDEX, PAGE 687

LONDON:

CHARLES GRIFFIN AND COMPANY, LD.  
 EXETER STREET, STRAND.

1899.

*Journal of Anatomy and Physiology* July 1899. 17th Year.

FIG. 1. ADDISON ON ABDOMINAL VISCERA IN MAN

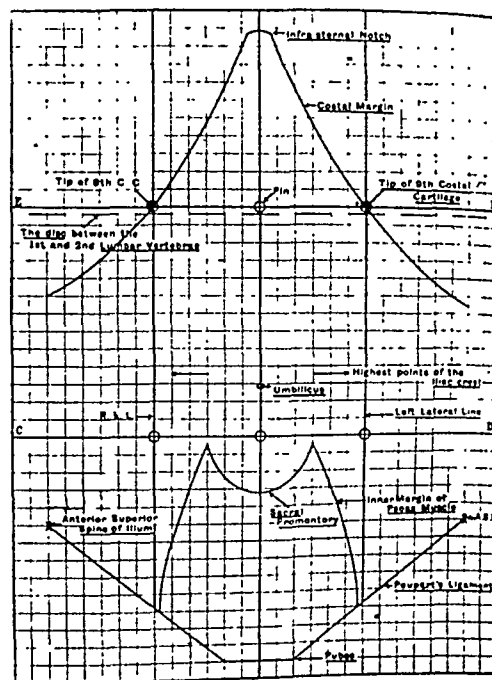


FIG. 1.—Diagram showing the average position of the landmarks whereby the abdominal regions are limited

FIG. 52A.

ON THE TOPOGRAPHICAL ANATOMY OF ABDOMINAL  
VISCERA IN MAN, ESPECIALLY THE GASTRO-IN-  
TESTINAL CANAL.<sup>1</sup> PART I. By CHRISTOPHER ADDISON,  
M.D., B.S. (Lond.), F.R.C.S., *Professor of Anatomy, University  
College, Sheffield.* (PLATES XLIII.-XLIV.)

PURPOSE OF INQUIRY.

With the advance of medical and surgical science, especially with regard to the operations of surgery on the abdomen, the topography of the abdominal viscera becomes of increasing importance.

The method of determining the position of the underlying parts should be as simple as possible, it should be convenient of application, and, withal, having regard to the varying conditions of the abdominal organs, as accurate as can be. One seldom meets with an abdomen which can be called normal in all respects.

The distance from the pubes to the supra-sternal notch is measured by drawing the tape tightly between these points. If the abdomen is convex, the half-way point is marked directly; if concave, the spot directly beneath the mid-point of the tape is taken; and at this point, after a small skin incision, a long steel pin is driven through the abdomen. This marks the level of the upper transverse abdominal line (E.F.).

<sup>1</sup> Read before the Royal Society, December 8, 1898. Communicated by Professor Alexander Macalister, F.R.S.

The average length of the abdominal part of the trunk was 35.8 cm., leaving the manubrium and body of the sternum a total average length of 16.2 cm., or 9.8 per cent. of the total height of the individual. Wright (9) gives the average for males as 9.65 per cent., and for females 9.22 per cent.

The average distance between the transverse lines was 13 cm., or a little over 5 inches. The average distance of the infra-sternal notch<sup>1</sup> above E.F. was 9.8 cm., nearly 4 inches, thus leaving a not too large interval between the body of the sternum and the upper transverse abdominal line. The maximum in this distance was 11.5 cm., and occurred only in 2 cases, and there were only 2 cases in which the distance was less than 8 cm.:—these cases being 7.25 cm. and 7.75 cm. respectively. In such a diversity of subjects, with so different characters of the chest and abdomen, this variation is small.

*The line E.F.*—Since the mid-point of the distance from the pubes to the supra-sternal notch is taken quite regardless of the condition of the body whether fat or thin, with the abdomen or chest distended or not, the regularity of the position found to be occupied by the line E.F. renders it a most useful line for surface marking.

My purpose, however, in selecting the transverse lines I have described, was simply the obtaining of easily-found, equidistant points for the purpose of measurement; and I was not prepared for the regularity of position in regard to the vertebrae and other structures which, especially, the upper transverse line E.E. has been found to possess. It corresponds almost accurately to the disc between the 1st and 2nd lumbar vertebrae, and cuts the junction of the 8th and 9th costal cartilages at the tip of the 9th.

<sup>1</sup> By the infra-sternal notch is meant the notch at the lower border of the sternum between the two 7th costal cartilages, as it can be felt and located on the surface. By the anterior superior iliac spine is meant that spot where the crest of the ilium, as felt through the skin, ceases, and where Poupart's ligament begins. The xiphoid cartilage is in all cases neglected.

FIG. 52B.

FIG. 52A and B. Title page of *The Journal of Anatomy and Physiology* containing Addison's description and excerpts from it.

## QUESTIONNAIRE

1. What is the general shape of the abdominal cavity?
2. In what diameter is the abdominal cavity most narrow?
3. What is the narrowest point in the anteroposterior diameter of the abdomen?
4. Is the abdominal aorta normally palpable? If so, where?
5. What is the significance of palpation of the abdominal aorta in the epigastric region?
6. What information may the clinician gain when he is able to palpate the abdominal aorta?
7. With what may the palpable abdominal aorta be confused? How may proper differentiations be made?
8. What is the most important matter to determine clinically in regard to abdominal wounds?
9. Explain how intra-abdominal structures may be severely injured without evidences of gross injury to the abdominal wall itself?
10. State, in general, the methods of treatment of injuries to the abdominal wall itself.
11. State what may be done for the patient with a penetrating wound of the abdomen while he awaits operation.
12. Should all cases of perforated wounds of the abdominal wall be operated upon? If so, why? If not, when should expectant treatment be employed?
13. What percentage of gunshot wounds of the abdomen perforate abdominal organs? How many perforate intestinal tract?
14. What are the chief causes of death following perforation of abdominal viscera?
15. What percentage of patients with perforated wounds of the abdomen recover without operative interference?
16. What percentage of cases of gunshot wounds of the abdomen recover following operation? In civil practice? In war practice?
17. What factor, more than any other, influences the mortality rate with perforated abdominal wounds treated by operation?
18. Give the importance of the time factor in operations for abdominal perforations (statistical results in general).
19. Name some of the chief signs and symptoms caused by rupture or perforation of a loop of small bowel.
20. Explain how the following symptoms and signs originate after perforation of bowel: pallor, shoulder pain, hiccough, absence of liver dulness, shifting dulness in the flank, leucocytosis, dyspnea, shock.
21. What is the typical leucocytic curve following a subserous hemorrhage?
22. What are the chief signs and symptoms produced by free fluid in the peritoneal cavity? By free gas?
23. Name some of the evidence leading to a diagnosis of rupture of the bladder.
24. What intra-abdominal conditions are most often suspected after simple strains of the abdominal muscles?
25. In what types of patients are simple muscle strains of the abdominal walls to be especially looked for?
26. What is a desmoid tumor?
27. Give some important points concerning desmoid tumors.
28. How may intra-abdominal tumors and tumors of the abdominal walls be differentiated?
29. What is meant by the "line of congenital anomalies?"
30. Why are congenital abnormalities so frequently found in the midline of the body?
31. Why do congenital anomalies require particular care for their surgical cure?

32. Name ten or more congenital defects which may be found in the midline of the body.
33. What is an epigastric hernia? Varieties of epigastric hernias?
34. What are the symptoms produced by an epigastric hernia?
35. What disease may be most closely simulated by an epigastric hernia?
36. What is the meaning and derivation of the following words: umbilicus, navel, omphalos?
37. Explain the spontaneous cures of umbilical hernias which so often occur during infancy.
38. What are the ligaments of the umbilicus?
39. Explain the central depression of the umbilicus.
40. State some of the reasons why the umbilicus is of special importance to the surgeon.
41. What is pyelephlebitis?
42. What is the caput Medusae? Explain mechanism of its production.
43. What is the origin of the term caput Medusae?
44. What are the nerves found in the umbilical region?
45. What lymph glands are present near the umbilicus?
46. What is the drainage of periumbilical lymphatics?
47. Has the umbilicus a muscle layer? Name the tissues found at the umbilicus.
48. Name the arteries and veins of the umbilical region; from where are the former derived? To where do the latter drain?
49. What is the urachus? The allantois?
50. What is a patent urachus? Its symptoms? Frequency?
51. What is the round ligament of the liver? Its origin?
52. When may the surgeon find it of advantage to sever the round ligament of the liver?
53. What vessels pass through the umbilicus during fetal life?
54. What vestigial band passes at times from the superior mesenteric artery to the umbilicus?
55. What is a Meckel's diverticulum? Its normal incidence?
56. What is the origin of Meckel's diverticulum?
57. Give another name for Meckel's diverticulum.
58. What intra-abdominal pathological conditions are caused by persistent diverticuli?
59. What is the final site of embryonic closure of the anterior body wall?
60. When is herniation of the bowel through the umbilicus a normal condition?
61. What special precaution must be taken in opening the sac of an umbilical hernia?
62. How may small umbilical hernias most easily be detected?
63. What special preoperative precaution is important in dealing with huge umbilical hernias?
64. What is the chief difficulty during operation for large umbilical hernias? What special factor contributes to the high postoperative mortality of this condition?
65. What is meant by topography? Origin of word?
66. What are some of the difficulties encountered in creating a satisfactory system of topographical markings?
67. Name and bound the chief abdominal topographical areas.
68. Give the complete boundaries of the hypochondrium.
69. Name some of the transverse topographical planes used in reference to the abdomen.
70. What abdominal landmarks (external walls) are fixed and constant and which are movable or inconstant?
71. What is Addison's line? The midepigastric plane? The transpyloric plane?
72. With what intra-abdominal structures is Addison's line associated?



73. What vertebra does Addison's line overlie?
74. Name some of the chief abdominal topographical points.
75. Where is McBurney's point? Its significance?
76. Where is Robson's point? Its significance?
77. Where is the point of greatest tenderness with acute diseases of the gall bladder? Why does this point vary with different individuals? How does it vary? How localized?
78. Bound Hesselback's triangle, Petit's triangle, Scarpa's triangle. What is the chief surgical significance of each?
79. What is meant by triangles of cutaneous hyperesthesia? Do they correspond accurately with Head zones or the distribution of peripheral nerves? If not what is their significance and value?
80. What is meant by a "flexible system of topography?"
81. Give examples of the use of such a flexible method.
82. What normal intra-abdominal structures may most frequently be palpated through the anterior abdominal wall?
83. What intra-abdominal masses are most frequent in each of the abdominal topographical zones?
84. What is the most common cause of the pains referred to each of the abdominal topographical zones?

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# The American Journal of Surgery

NEW SERIES, VOL. VIII

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No. 4

## CHRONIC LEG ULCERS

### TREATMENT WITH UNNA'S PASTE BOOT

R. A. CUTTING, M.D., PH.D.

NEW ORLEANS, LA.

OF ALL the cases coming under the care of the surgeon perhaps none is more aggravating than the case of chronic leg ulcer. Patients presenting chronic leg ulcers are frequently in rather good health except for their local lesions, and may even feel in no way incapacitated for the regular duties of a more or less active life. Leg ulcers, however, are loathsome lesions, particularly to a person of sensitive disposition, and any relative lack of physical incapacitation shown by the victim may be more than offset by a deleterious effect on his psychological reactions. Patients with incapacitating lesions of far less actual significance than these usually take to bed as a matter of course and are content to remain at rest until such time as nature shall have had a chance to establish the process of repair; patients with chronic leg ulcers, however, tend to become restless when confined to bed and sometimes, taking matters into their own hands, may insist upon ambulatory treatment. Such treatment failing, they tend to drift from one surgeon to another without finding permanent relief, ultimately lose confidence in the medical profession at large, and soon fall easy prey to patent medicines and to various forms of actual quackery.

No single measure can be advocated as a therapeutic panacea for all chronic leg ulcers, since these ulcers vary so widely

in their etiology, but, combined with appropriate accessory therapy, there never has been devised a more efficient treatment than the Unna's paste boot or stocking. Unna's paste is no new substance, having been devised by the Hamburg dermatologist, Paul Unna, who was born in 1850; the method of fashioning this paste into a boot or stocking is also not new, having been used extensively for the purpose in question by many able surgeons both past and present. The author, furthermore, wishes to disclaim all credit for originality in the details of preparing and applying the device, since, in the description of the technic which is subsequently given, he follows a method which has been recognized and practiced with success by many individuals for several years. He feels, however, that the device has not received the general recognition which its value justifies and believes that if the rationale of its use and the method of its preparation were more generally known it would be more frequently provided, and patients consequently would not only be spared much suffering, both physical and mental, but would also be saved many days of economic usefulness.

Complicating the luetic ulcer, the pressure ulcer, and the mycotic ulcer, and tending to reach its acme in the varicose ulcer, is almost invariably a certain degree of local venous stasis and associated tissue

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OF ALL the cases coming under the care of the surgeon perhaps none is more aggravating than the case of chronic leg ulcer. Patients presenting chronic leg ulcers are frequently in rather good health except for their local lesions, and may even feel in no way incapacitated for the regular duties of a more or less active life. Leg ulcers, however, are loathsome lesions, particularly to a person of sensitive disposition, and any relative lack of physical incapacitation shown by the victim may be more than offset by a deleterious effect on his psychological reactions. Patients with incapacitating lesions of far less actual significance than these usually take to bed as a matter of course and are content to remain at rest until such time as nature shall have had a chance to establish the process of repair; patients with chronic leg ulcers, however, tend to become restless when confined to bed and sometimes, taking matters into their own hands, may insist upon ambulatory treatment. Such treatment failing, they tend to drift from one surgeon to another without finding permanent relief, ultimately lose confidence in the medical profession at large, and soon fall easy prey to patent medicines and to various forms of actual quackery.

No single measure can be advocated as a therapeutic panacea for all chronic leg ulcers, since these ulcers vary so widely

in their etiology, but, combined with appropriate accessory therapy, there never has been devised a more efficient treatment than the Unna's paste boot or stocking. Unna's paste is no new substance, having been devised by the Hamburg dermatologist, Paul Unna, who was born in 1850; the method of fashioning this paste into a boot or stocking is also not new, having been used extensively for the purpose in question by many able surgeons both past and present. The author, furthermore, wishes to disclaim all credit for originality in the details of preparing and applying the device, since, in the description of the technic which is subsequently given, he follows a method which has been recognized and practiced with success by many individuals for several years. He feels, however, that the device has not received the general recognition which its value justifies and believes that if the rationale of its use and the method of its preparation were more generally known it would be more frequently provided, and patients consequently would not only be spared much suffering, both physical and mental, but would also be saved many days of economic usefulness.

Complicating the luetic ulcer, the pressure ulcer, and the mycotic ulcer, and tending to reach its acme in the varicose ulcer, is almost invariably a certain degree of local venous stasis and associated tissue

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edema. Malignant ulcers, neuropathic ulcers, and tuberculous ulcers frequently show varying degrees of the same phenomenon. This stasis and edema is not, of course, the exciting cause in the development of any of these lesions, not even the varicose ulcer, which does not develop in the absence of trauma, but when once such lesions have become established the stasis and edema may be sufficient to hinder seriously or even actually to prevent the process of complete repair. The process of repair consists not only of the deposition of new tissue, but of the removal of devitalized and partially autolysed debris. Whenever the venous return from an injured area is so disturbed that this removal of tissue debris is interrupted, the local tissue spaces, the lymphatics and the venous capillaries become clogged, arterial blood is mechanically prevented from reaching the scene, such adjacent tissues as are still vital tend to be deprived of their oxygen supply, and local acidosis and progressive death of tissue ensues. Unless some method of breaking this vicious circle be invoked the best that can be anticipated is a sort of equilibrium between the forces of destruction and the forces of repair in accordance with which alternately now the one and now the other is in the ascendancy, the result being an "indolent" lesion which stubbornly refuses to heal.

If patients with these indolent ulcers can be persuaded to remain in bed for a period of weeks, associated infection of the ulcerating area being controlled meanwhile by the use of hypertonic saline solutions and heat, appropriate accessory treatment also being provided in the form of antisiphilitic treatment for the luetic ulcer, formal operation upon, or the injection of sclerosing solution into varicose veins, in connection with varicose ulcers, the exhibition of massive doses of iodides by mouth in mycotic ulcers (grs. 30-100 t.i.d.), and the like, there are very few cases of chronic leg ulcer which will not eventually proceed to complete healing. General bodily rest

undoubtedly plays some part in the production of this healing, since it allows a concentration, so to speak, of the entire excess of body energy on the affected area, but the local relief of blood and tissue fluid stasis is much more fundamental and important, and is undoubtedly the factor primarily responsible for the good clinical results obtained by the non-ambulatory treatment.

Much has been written on the ambulatory treatment of varicose ulcer, which, of course, is the chronic leg ulcer ordinarily presenting stasis and edema in its most characteristic form, and almost without exception, when reduced to their essentials, the methods involve the application of local mechanical support to the part. The multiplicity of devices used to produce such support, though indicating that none of them perfectly realize the end for which they were designed, nevertheless bear mute testimony to the correctness of the principle involved. Most practitioners of experience have seen certain chronic ulcers heal under the simple expedient of local support by criss-cross adhesive plaster strapping; local elastic pressure as obtained by the use of inflatable rubber bags or balloons, or by the resilient porous rubber sponges of ordinary commerce, should also produce excellent results in certain selected cases. Such devices, however, would seem to have a rather limited scope of usefulness, since the usual indication is for a much more extensive support than they can easily be made to achieve. In relatively few cases is stasis limited to the area of the lesion, and when ulcerations are of considerable extent or, though relatively small, have existed for considerable periods of time, stasis and edema are very apt to be not localized at all but generalized below the knee. The ideal mechanical treatment would therefore seem to be some form of support which would exert gentle and equal pressure over the entire surface of the foot and leg, and which, accordingly, would assure for the ambulatory patient essentially the

same condition which is obtained in the case of the recumbent patient, an extremity devoid of venous and lymph stasis.

The elastic stocking can be made to serve this supportive function fairly well, but is subject to certain almost completely unavoidable disadvantages:

1. When produced in quantity and bought by the patient ready-made elastic stockings are apt to fit poorly; when made to order they are relatively expensive.

2. Even though initially carefully and accurately fitted to the individual patient, the device may very soon become quite worthless, due either to loss of elasticity of the stocking or to actual changes in the shape and size of the limb as the case progresses toward healing.

3. In order to be really effective the stocking must be applied before arising in the morning, i.e. after the recumbent attitude assumed during the night has relieved the affected part of much of its fluid stagnation, and it should be applied after the extremity has been held for a number of minutes nearly vertical in order to facilitate still further reduction in size. Patients of limited intelligence usually fail to appreciate the necessity for attention to this part of the technic, and all patients tend to become careless in observing instructions; occasionally they may even neglect to wear the apparatus for days at a time.

4. The elastic stocking is difficult to keep clean when used in the treatment of an ulcer because of almost unavoidable contamination by secretions, and any attempt to modify the device by cutting holes or windows in it to allow treatment of the ulcer without removing the stocking defeats the entire purpose of the treatment, since it abolishes support over the area where it is most needed.

The elastic roller bandage would be of more value to patients than it is were it not so difficult to apply single-handed and were the patient's intelligence and understanding of the anatomy and physiology involved as complete as that of the medical

attendant who prescribes the mode of treatment. Unfortunately patients advised to use the elastic rolled bandage rarely receive from it the amount of benefit which they might reasonably be expected to enjoy.

The Unna's paste boot is subject to none of these disadvantages, whereas, at the same time, it affords better support than either the elastic stocking or the elastic bandage.

1. The boot is a custom made, built-up affair, which conforms exactly to the shape of the part, because it is applied like a cast. The materials from which the boot is made are relatively inexpensive and can be easily obtained and prepared by almost any practitioner, nearly anywhere, and in the absence of elaborate technical facilities.

2. The boot does not stretch, and when it ceases to fit accurately, due to changes in the shape and size of the part, it can, without compunction, be removed and replaced with another because of its inexpensiveness.

3. Being molded to the part it cannot be replaced by the patient after it has been removed, and, accordingly, the patient is completely under the control of the surgeon at all times; the apparatus functions perfectly regardless of the patient's intelligence or cooperation.

4. Being composed partly of zinc oxide and being relatively impenetrable to secretions, it can be used directly over open ulcers and does not speedily become objectionable through absorption of secretions. When soiled it is not washed and replaced, but cut away and discarded. The Unna's paste boot is never fenestrated, consequently it provides uniform support over the entire extremity.

Unna's paste consists of 4 ingredients (there seems to be no good reason for modifying its composition by the addition of other substances):

Zinc oxide	4 parts
Gelatin	4 parts
Glycerine	10 parts
Water.	10 parts



The formula is easy to remember since it consists of four parts of each of the two solid constituents and ten parts of each of the two liquid constituents.

The only substances entering into the formula which may possibly have some function other than a supportive one are the zinc oxide and the glycerine. Zinc oxide is classified pharmacologically as an astringent; it is possibly a very feeble antiseptic. Inasmuch as it is of little or no value when used by itself on indolent ulcers, the presumption is that its value when used as one of the ingredients of an Unna's paste boot is not dependent upon its pharmacological action. The same line of reasoning may be used for glycerine. Glycerine is classified as a mild antiseptic; it is also somewhat hygroscopic. Its antiseptic properties are so slight, however, that it is used as an ingredient in certain culture media, and its hygroscopic properties apparently have little to do with its usefulness in connection with the Unna's paste boot, as the boot does not become noticeably damp, and secretions even from open ulcers penetrate it only relatively slowly. Furthermore, there seems to be no apparent reason why the combination of zinc oxide and glycerine or indeed the combination of all four ingredients, zinc oxide, gelatin, glycerine and water should act essentially in any except a mechanical manner; certainly the mixture when applied as an ordinary dressing to indolent ulcers produces no such spectacular results as when applied in the form of a well-fitting boot or stocking.

The application of an Unna's paste boot is accordingly believed to accomplish, by a mechanical appliance, for the ambulatory patient exactly the same state of affairs as is accomplished for the recumbent patient by posture. The only advantage which the bed patient has over the ambulatory case with a well-applied Unna's paste boot is general bodily rest, an advantage which is probably of little actual importance in the average case of chronic leg ulcer.

The theoretical value of the method is amply attested by the practical results. Given 2 patients with similar lesions and treated exactly alike except that one is put to bed and kept there while the other is treated with an Unna's paste boot and allowed to go about his daily duties, the latter will improve almost exactly as fast as the other and will be a much more contented and grateful patient.

In applying an Unna's paste boot it is important to observe strictly the following technic, since modifications, however well meant, may make the difference between complete success and utter failure.

Previous to the application of the boot in cases in which open ulcers are present on the lower extremities or in which edema is extreme, a day or two, occasionally several days, of hospitalization with rest in bed and elevation of the part may be desirable in order to relieve edema and control gross infection. Patients with foul ulcers should be put immediately into a hot bath. In the control of infection there is no agent which compares in efficiency with the use of hot, moist compresses of magnesium sulphate solution of about 10 per cent strength. Such a solution is sufficiently hypertonic to prevent maceration of tissues and also to withdraw from the tissues plasma and tissue fluids which in their passage outward serve most efficiently to wash away bacteria and minute particles of decomposing tissue and to bring antibodies into the affected area. Magnesium sulphate itself possesses the well-known property of acting as a local anesthetic when applied to denuded surfaces.

The modern tendency in the treatment of infection is almost entirely away from the use of antiseptic in any case, but in preparing patients for the application of an Unna's paste boot one should particularly avoid antiseptics, since ultimately the entire involved area is to be sealed over.

Patients may be considered ready for the application of the boot whenever the

area surrounding the ulcer no longer shows the classical evidences of inflammation (local heat, redness, swelling, and

should not be heated much above the melting point of the glycerine, since it is subsequently applied directly to the skin



FIG. 1. Method of preliminary draining of venous blood and tissue fluids from foot and leg just prior to application of Unna's paste boot. Part is kept elevated for at least five minutes.



FIG. 2. Proper position of foot and leg during application of boot; foot is held by toes. First turns of bandage at base of toes and just below knee are in place.

tenderness) and when during a period of observation of twenty-four hours the foot and leg are found to undergo but little decrease in size.

At this time and prior to the application of the boot, if the ulcer is a varicose ulcer, the injection of the regional varicose veins may be begun. One or more injections may be conveniently made at this first treatment, the boot being subsequently applied and worn, and at the time of subsequent applications of the boot additional injections may be made.

Having controlled infection to a reasonable extent and having drained the limb of excessive edema, the Unna's paste boot is applied in the following manner:

The ingredients of the Unna's paste are mixed together,\* placed in the inner compartment of an ordinary double boiler or rice cooker, and liquefied by means of heat. The proper consistency of the paste just prior to use should be that of thick cream or thin batter, and the mixture

and will require cooling before it can be applied if initially heated to too high a temperature. Furthermore, an excessive amount of heat or unduly prolonged heat interferes with the subsequent "setting" of the paste.

The boot is best applied to the patient after at least one night of rest in bed, before he has been allowed out of bed in the morning, and after at least five minutes of elevation of the part (Fig. 1). If hairy, the patient's foot and leg should receive preliminary shaving. In any case the foot and leg should, of course, be scrupulously clean.

The application proceeds with the patient lying on a table or bed in dorsal decubitus, the leg being flexed upon the thigh and the thigh being flexed upon the abdomen; an attendant steadies the foot by grasping the patient's toes.

The position in which the leg and foot are held prior to and during the application of the boot are most important both from the point of view of the efficacy of the treatment and the patient's subsequent comfort. The flexion of leg on thigh and thigh on abdomen relaxes the calf muscles of the leg and makes possible the applica-

\* In case the gelatin to be used is of the solid or "flake" variety, and best in any case, the gelatin and water may be allowed to stand in contact over night; complete liquefaction of the mass with heat on the following morning, addition of the glycerine and then of the zinc oxide, with constant stirring, follow.

tion of a snugly fitting appliance; the dorsiflexion of the foot ensures subsequent comfort in walking and guards

are permitted. At those places at which folding or "reverse turns" would be required, the bandage is simply cut across



FIG. 3. Method of applying Unna's paste with ordinary paint or varnish brush. Gauze roller bandage is held in position ready to cut. Bandage is cut across and started again at different angle in order to avoid making of "reverse turns."

against any tendency to the production of foot-drop.

The first step in the actual application of the boot consists of making a turn and a half of loose-meshed gauze roller bandage about the foot at the base of the toes and another turn and a half about the leg just below the knee. The bandage should be about 2 in. in width. (Fig. 2.)

The Unna's paste, being of the proper consistency and not too hot, is now applied directly to the skin by means of 2 in. paint or varnish brushes from the region of the base of the toes to the bend of the knee, no portion of the surface being exempt, not even open ulcerated areas, the paste being carried almost to, but not quite to the outer edges of the two bands of gauze just previously applied. As soon as the initial layer of Unna's paste has been applied to the skin surface and without undue delay a layer or two of the loose meshed roller bandage is applied directly over it. This layer completely covers the area previously covered by the paste. No folds of roller bandage, or "reversed turns" as they sometimes called,



FIG. 4. Unna's paste boot completed. Note difference in size between two limbs. Circumference of treated foot and leg is much smaller than that of opposite extremity, even disregarding thickness of boot. Support provided by boot is quite evident.

with a pair of scissors and the winding is recommenced at the desired angle. The bandage, like the original layer of Unna's paste, extends from the base of the toes to the bend of the knee and covers the foot and leg, including the heel. A second layer of Unna's paste is now applied over the layer of gauze bandage and over this still another layer of gauze bandage. (Fig. 3.)

In this way the boot is built up to the required thickness; usually about 5 layers of gauze and 7 layers of Unna's paste are required to provide a boot of suitable thickness. The last layer of the boot should consist of Unna's paste, and the entire boot should be allowed to remain

exposed to the air until the surface has dried or "set" to such a point that it is no longer sticky or "tacky" to the touch. The surface of the boot, when almost dry, may conveniently be dusted over with some suitable dusting powder, such as powdered talcum.

The finished boot conforms, of course, precisely to the shape of the foot and leg, because it has been molded thereto; and the Unna's paste, when it has set, provides a support which is moderately elastic, which is not heavy or cumbersome, and which can be worn in complete comfort and without being particularly noticeable when covered by the patient's stockings (Fig. 4).

The patient may be allowed to dress and proceed with his regular duties as soon as the boot has become set and has been properly powdered.

A single application of an Unna's paste boot may suffice only in the simplest cases; usually one or many reapplications are required, the period of time required for complete healing of the ulcer being approximately the same as that which would be required in the recumbent treatment.

The question of the frequency with which Unna's paste boots should be changed is one of individual judgment. In those cases in which no open ulceration is present properly applied boots need not be changed for relatively long periods of time, frequently several months. The principal indications for the removal and reapplication are: (1) soiling of the boot and (2) changes in the extremity such that the boot no longer fits and provides the support for which it was originally intended. In those cases in which extensive areas of ulceration exist and quantities of exudate are continually being discharged the boot may become soggy and require changing at much more frequent intervals, occasionally every three or four days. Perhaps in average cases the boot may be

allowed to remain for a period of three weeks or longer.

The reapplication of an Unna's paste boot is a relatively simple matter. The boot is removed with scissors in the evening, the patient being given a hot bath with plenty of soap and water. The patient is immediately put to bed and remains there until the boot is reapplied on the following morning. The reapplication is made precisely as in the original application.

One of the cardinal principles in the application of the Unna's paste boot and one which can never be disregarded is that no windows or doors shall be cut in it.

Furthermore, one should not discontinue the use of the boot too soon; otherwise the freshly healed areas may promptly break down and ulcerate again. It is better to err on the side of conservatism and continue the treatment for some weeks beyond the time limit dictated by one's first judgment and to reapply the boot subsequently at the first sign of reappearance of the lesion.

The Unna's paste boot, serving as it does a purely mechanical function, cannot be expected to take the place of essential therapy: antisiphilitic treatment, iodides internally, the recognized methods for the treatment of associated varicose veins, wide excision of malignant tissue, and the like.

If the principles of application as previously outlined are strictly followed and suitable accessory treatment is provided, the application of the Unna's paste boot provides a form of treatment which is nothing short of a revelation to one who has tried many of the other practical methods of treatment of chronic leg ulcers. By use of this simple expedient many cases which previously were a source of vexation and disappointment will be transformed to cases providing real satisfaction and pride.



# THE SURGICAL ASPECTS OF BILIARY DISEASE\*

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TO advise appropriate treatment in gall bladder disease it is essential to understand the anatomical and pathological conditions present. It is necessary to estimate the relative importance of symptoms and to correlate them properly with the pathology. We should not think of these cases as gall stone cases for the stones are only incidental to the disease. They are but an expression of the inflammation and not always present. While they may cause symptoms it is the underlying inflammation which must be treated. If during the progress of the disease this inflammation becomes quiescent the stones will no longer give trouble, but so long as the inflammation recurs so long will symptoms persist due in some instances to the stones but in more instances to the inflammation itself and the results of the inflammation,—adhesions, stricture of ducts, perforation, gangrene, peritonitis, cholangitis, liver insufficiency, hepatitis, liver abscess; distant infections from the local focus such as myocarditis, renal insufficiency, pulmonary infections, joint complications; involvement of neighboring organs through extension of the inflammation such as pancreatitis, perforation into the stomach, duodenum or colon, adenitis causing pressure on the common duct either beneath the liver or at or near the ampulla of Vater; carcinoma of the gall bladder following long continued chronic irritation.

Not all cases need operation for not all progress to the stages and results indicated. Many cases become quiescent. It is estimated that of every 100 cases 80 either become quiescent or present such minor disturbances as not to interfere very much with the patient's well being and therefore do not require surgical intervention. Of the remaining 20 there are perhaps 15

in whom operation is distinctly indicated and five in which it is a question of judgment as to whether or not operation should be performed.

It is absolutely essential that the anatomy, physiology and pathological processes involved in the disease and in its complications be clearly understood in order to not only arrive at a correct diagnosis but also, based on that diagnosis, to be able to forecast what will probably be the course of the case and so be able to advise as to treatment. We must correlate the symptoms presented at the time of examination and disclosed by a careful analysis of the history and the physical findings. In no other disease is experienced judgment so necessary. To successfully treat this disease one must not only look at it from the medical but also from the surgical aspect. There is no other disease where differences of opinion are so prevalent. For example, for years patients have been taught to look upon gall stones as the name of their trouble whereas the stones are merely a product of the underlying inflammatory condition. The basic disease is the inflammatory change in the gall bladder wall. As long as the underlying pathological changes persist the formation of stones continues. When we speak of stones we mean not only stones free in the gall bladder but also the calcareous deposits which form on the gall bladder wall.

Before considering what should be the logical treatment in gall bladder disease let us first study how nature sometimes causes the disease to become quiescent.

In the natural course of gall bladder inflammation it sometimes happens that the inflammatory changes progress to a point where they are no longer active. In some cases the gall bladder becomes a

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fibrous mass without function the stones being imbedded as foreign bodies. In such a process the more extensive the original inflammation the more fibrous tissue will form and the greater will be the cicatricial shrinkage, the mucosa will be completely destroyed so that the gall bladder becomes a more or less solid cicatricial mass with trabeculae of fibrous tissue tightly enclosing the stones and entirely isolated from the common duct. Nature has done what the surgeon does when he performs a cholecystectomy. In such cases symptoms can no longer be produced by further inflammatory changes in the gall bladder itself. What symptoms do remain are due to adhesions and changes outside of the gall bladder as a result of the formerly active inflammation. Whether symptoms persist from the extrinsic inflammatory changes depends upon the location of such changes. There are not so many gall bladder cases which go on to this final stage with its extensive fibrous tissue changes without, in the course of the disease, producing recurrent disabling symptoms nor can such a final result be relied upon.

A second form of final pathology is hydrops of the gall bladder. A stone remains tightly wedged in the cystic duct or in the neck of the gall bladder. The contents which were in the beginning products of inflammation become sterile, the gall bladder wall becomes overstretched, the mucous lining is destroyed by inflammation, the wall becomes fibrous so that pain is no longer felt nor a sense of pressure. Such a case is proof that even without the removal of the stone a gall bladder inflammation can reach a quiescent stage. It shows that if latency of the inflammation occurs the stone or stones need occasion no anxiety. We rarely, however, see true cases of hydrops. A peculiar thing about hydrops is that because it results in a large and easily palpable tumor patients are quite anxious for an operation on that account and physicians more readily turn such cases over to the surgeon whereas, as a matter of fact, it is not at all necessary to operate on cases of

hydrops. They rarely present symptoms of either pressure or pain. The removal cannot better the patient's condition except to relieve his mind of the anxiety he feels knowing that he has a tumor. I do not think I have operated upon more than half dozen cases of hydrops in some two thousand cases of gall bladder disease and then only when the patient was anxious to be relieved of a tumor though the symptoms therefrom were slight.

Another of Nature's so-called cures is the formation of a fistula between the inflamed gall bladder and some portion of the gastro-intestinal tract, usually the duodenum or the colon. Nature thus not only furnishes a free exit for the normal secretions but also for the products of inflammation.

Still another of Nature's cures is total calcification of the gall bladder, a rare condition.

Such advanced pathological changes are rare. It would be a mistake to wait. Many patients would have no chance to escape an early death. If, as is considered by many, it is unwise to operate in every attack of gall bladder disease it is still just as unwise to wait too long.

In the life history of the disease there are many and often long periods of quiescence.

The above brief resumé of pathology in certain advanced gall bladder cases does show us, however, that the important point is the cure of the inflammation no matter how expedient it may be to remove the stones. If latency could be brought about by diet, medication or treatment other than operation it would of course be preferable. Can latency be brought about by such means or does latency occur irrespective of medical treatment? My impression is that gall bladder disease is a chronic progressive inflammation and that with each attack the gall bladder becomes more and more disabled. The frequency of the attacks, their acuteness and their duration depends upon the severity of the inflammation. For instance, inflammations producing cholestrin stones

are more apt to become latent than other inflammations though the cholestrin stone may lodge in the cystic duct or in the duodenal papilla. In the latter location in the retroduodenal part of the common duct where even in the normal state bacteria are present cholangitis follows very quickly. The removal of a stone so located is therefrom indicated in order to prevent infection. Generally speaking, whether medical treatment or surgical is advisable is according to the grade of the infection and its duration and its effect on the function of the liver.

We have indicated in the opening of this talk that eighty per cent of cases do not require operation for the reason that their symptoms are so slight as not to disable the patient or cause much pain or disturbance. We also indicated that fifteen per cent required operation and of the remaining five per cent it was a question of judgment as to whether operation should be done or medical treatment should be employed. Let us take up very briefly from the surgical standpoint what gall bladder cases may be treated without operation. Medical treatment is indicated in all acute inflammations of the gall bladder showing a tendency to subside with the exception of acute cholecystitis with gangrene, perforation, empyema and cholangitis. Medical treatment is also indicated in all chronic cholecystitis cases which tend toward latency and in hydrops of the gall bladder and in cholecystitis cicatrans not giving pain. Why is medical treatment indicated in these acute and chronic inflammations? In the acute because they are temporary and in both acute and chronic because they are not disabling, do not give the patient much discomfort and do not interfere to any great extent with his enjoyment of life nor his ability to earn his living.

Operation is indicated in acute cholecystitis which does not subside quickly, cholangitis both acute and chronic, gangrene of the gall bladder, perforation of the gall bladder, beginning carcinoma of the gall bladder, in all cases of chronic

cholecystitis, of which there are many forms, in which health is affected over a period of time either through recurring attacks of pain or which cannot be brought to a degree of latency which permits of comfortable digestion and the pursuit of livelihood without too much interference.

There are two classes of cases; those in which operation must be done at once in order to save life and those in which we have time to consider whether operation is advisable or not. In the first it is the physician and surgeon who must throw the weight of their experience in the balance to cause the patient to decide and must insist upon an immediate operation. In the second class there is time in which the case may be studied, discussed with the patient and a mutual decision arrived at in accordance with the degree of interference with the patient's comfort and livelihood. In the first class are the cases of acute cholecystitis not rapidly subsiding, the cases of sero-purulent chronic cholangitis, acute cholangitis, gangrene of the gall bladder and perforation of the gall bladder. In the second class are the cases of beginning gall bladder carcinoma and the cases of chronic cholecystitis in which the patient's comfort and livelihood are being materially affected. I think that all physicians and surgeons can agree with this classification. Certainly in the first group we can all agree as these septic conditions are a direct and immediate menace to life. In the second group it is really up to the patient to give the final decision. He knows and he alone knows how much interference there is with his comfort and livelihood. We can, however, lay before such a patient his probable chances for cure or at least for the decided amelioration of his symptoms by operation and also the mortality of such operation in skillful hands. In many cases it will happen that in spite of recurring disabling symptoms the patient will so dread an operation as to refuse it when the attack has once subsided. Unfortunately for these patients their chances of recovery and of cure following operation are greatly en-

hanced if the operation is done between the attacks at a time when the minimum of inflammation is present, when they feel quite well and free from symptoms. If such patients are operated during an acute attack at a time when they will more rapidly submit to operation on account of their desire for relief of pain we cannot, in many instances, do a radical operation which will almost certainly relieve them, but must content ourselves on account of technical difficulties and dangers in doing a drainage operation thus leaving a gall bladder which in at least twenty-five per cent of the cases gives subsequent trouble. Frequently if it is explained to the patient that an operation between the attacks minimizes the possibility of a second operation the patient will more readily submit. If, however, the patient will only submit during an acute attack then it is again up to the physician to decide whether such an operation should be performed. In this decision he will be aided by a study of the history as to the degree of discomfort and disability. We hesitate to make an emergency operation of such cases because we know how much better a result can be achieved between attacks. Here let me interpolate a word of warning. The inflammation of the acute attacks does not subside as quickly as the subsidence of the symptoms indicates. I have operated three or four weeks after the subsidence of all symptoms and have still found a very considerable amount of inflammation so much so as to make ideal cholecystectomy of more technical difficulty than one would imagine. It is better to wait six weeks after a severe attack before operating if the condition of the patient will permit. It is certainly not sufficient time to operate a few days following an acute attack as is the custom so often in our hospitals. Our objective should be to lower the mortality of gall bladder surgery to a point that will approximate the true mortality of the disease itself and by so doing convince our medical friends of the advisability of early operation.

In the cases in which we advise operation

we base our advice on the degree of discomfort and interference with the patient's pleasures, comfort and livelihood. The symptoms need not necessarily be severe nor necessarily colics, they may be more in the nature of pressure sufficiently painful to aggravate the patient and to keep him from doing his work properly. Many such patients continue to work but their efficiency is impaired. Where patients present symptoms of nagging discomfort they should be advised that operation will cure or at least relieve them to a great extent. As a matter of fact patients presenting these symptoms between their acute attacks become worse and worse the longer they delay and finally must come to operation. The earlier the operation is done the better for them.

The presence or absence of stones is immaterial and should not be used as an argument for or against operation. This is particularly difficult because almost the first thing that the patient asks when he is informed that he has trouble with his gall bladder is "Have I stones?" and the public having been taught for generations by their physicians that it is the stones that give the trouble are apt to submit to operation more readily if they are told they have stones and that these will be given them after the operation. If one uses the argument of stones, which is the wrong argument to use, one would have to carry a collection of stones in one's pocket for emergency use. With increased efficiency in the technique of x-ray examination stones are being shown more frequently and in cases which never had symptoms of gall bladder disease sufficiently severe to require operation. If one were operating for stones one would be operating all the time. If one is operating to increase the patients efficiency and comfort and to lengthen his life one will operate only in accordance with sound indications, not stone indications. The decision to operate should be based on the severity of the symptoms rather than on the pathological changes present. The decision is founded on the history and the physical findings,



sometimes on the one alone and other times on the two considered together. We find gall bladder cases in which operation is imperative and in which there has been no history of more than previous trifling attacks until the present one which is so fulminating as to require immediate operative intervention. In such cases the decision is made upon the physical findings at the time of examination. We have other cases in which the physical findings are negative and in which the decision to operate is based entirely upon the history of repeated disabling attacks. A third group is composed of cases in which the history and physical examination must be considered in conjunction in arriving at a decision. Such cases may have very mild symptoms at the time of examination but their mild symptoms have been repeated so frequently in the past, as shown by the history, as to render operation advisable. In all cases the history is of the utmost value. It may take half an hour or more to get the details of the history while five minutes may be sufficient for the examination itself. Experience allows us to arrive at the causes of the different forms of jaundice, for instance, without the necessity of making all kinds of examinations of the urine, feces and blood. We should endeavor to make not only a clinical but also a pathological anatomical diagnosis. This is often though not always possible through study of the history alone experience making our diagnosis quite certain. Physical examination is not so certain. An educated sense of touch, however, can tell us much; we should learn to see with the ends of our fingers, to correlate the history and physical examination. In ninety per cent. of our cases we should arrive at a pathological anatomical diagnosis before opening the abdominal cavity. Such diagnosis can only be made after a study of hundreds of histories in connection with the operative findings. The physician should do this as well as the surgeon. There is no other way in which gall bladder disease can be learned. He

must attend operations and autopsies and learn to correlate the history and the physical examination with the findings. It is easy to make a diagnosis of gall bladder disease. It is not easy to diagnose the variety and extent of the disease, and above all it is not easy, unless one has studied the subject in the above manner, to decide which case requires operation and which may be treated medically. We see cases which have been treated medically and which present at operation fulminating inflammation and cases which present chronic empyema both of which conditions should have been sent to the surgeon long before. A proper knowledge of gall bladder disease would enable the physician to send such cases to the surgeon at a time when operation is practically without danger. Cases discussed by the physician and the surgeon will do much to help them both to properly care for this disease.

The presence or absence of symptoms cannot always be properly interpreted. There are cases which have no tenderness at all in the region of the gall bladder and yet at operation the interior of the gall bladder shows marked acute inflammatory changes which would undoubtedly have led, in a few days, to perforation. Nor can clinical symptoms always be depended upon. Many cases of empyema show slight or no fever; many stones in the common duct show no jaundice.

Pain is one of the indications for operation more so when recurring repeatedly and becoming more constant and especially when of a pressing character. It is usually the pain which causes the patient to consult the surgeon. More or less constant pain is practically always a symptom of chronic inflammation, but chronic inflammation does not always give pain. Some cases without pain show empyema of the gall bladder and some chronic cholangitis, in both of which operation is indicated.

Jaundice and enlargement of the liver are indications for operation just as pain is when the conditions are of a chronic character. In spite of the extensive studies

in gall bladder pathology there are physicians who cannot understand how the patient can have gall stones without jaundice. An acute attack of jaundice is not an indication for operation unless it appears coincidently with symptoms of acute inflammation. In the latter case the jaundice depends on involvement of the lymph glands around the head of the pancreas and along the common duct. In the majority of cases with acute jaundice the jaundice is caused by pressure on the common duct or acute closure of the duct. When a sudden closure of the duct is caused by stone there is an accompanying acute cholelithiasis. If the inflammation goes on to suppuration or becomes chronic jaundice will persist. In such cases operation should not be delayed. Early operation in cases of chronic closure of the common duct shows a mortality of three to four per cent; delay increases the danger threefold. In chronic cholangitis jaundice and colicky pain may disappear and chills and vomiting occur. The temperature may range as high as 104. Operation should not be delayed. It is useless to wait for the obstruction to be overcome by other than operative measures. There are occasionally reported cases with chronic closure of the common duct who have recovered without an operation. The quiescent period can only be temporary; the inflammation has subsided and the stone is resting. Sometimes the stone passes through the papilla or finds its way into a neighboring organ through ulceration. Though this occurs in a few cases and is Nature's attempt to cure it is unsafe to wait for such an event. Early operation gives a much lower mortality.

Some physicians rely upon the physical examination to give indications for operation. This is not always satisfactory; the history is what we depend upon most though in certain cases the physical examination is of decided value as in the following instances:

1st. An enlarged gall bladder not sensitive to pressure without jaundice. Is opera-

tion indicated? No. Why? Because such a condition is almost always a sterile hydrops of the gall bladder which is harmless.

2nd. An enlarged not sensitive gall bladder with jaundice. Should such a case be operated upon? Yes. Why? Because such a physical finding is usually carcinoma of the gall bladder, duct or pancreas, or a chronic pancreatitis. In such cases operation (cholecystenterostomy or cholecystgastrostomy) can in the case of cancer often relieve and if the case is one of chronic pancreatitis the operation may really prove curative.

3rd. An enlarged gall bladder with slight jaundice and with the gall bladder slightly sensitive to pressure. Should operation be done? Yes. Why? Because as in the second instance cited such a condition is usually one of carcinoma or chronic pancreatitis.

4th. A *very* tender and well circumscribed enlargement of the gall bladder with little or no jaundice. Should operation be done? Yes. Because such physical findings point to an inflammatory process of a seropurulent or purulent nature. Operation in such cases is not so urgent but still an operation must be done. Done early the mortality in such cases is about three per cent. and the mortality is increased by waiting. The operation is not so emergent as in:

5th. A case presenting the same symptoms and clinical appearance as are present in gangrenous appendicitis except as to the location of the pain which is in the gall bladder region and in which there may be only a little resistance over the gall bladder. Should operation be done in such a case? Yes. Why? Because these symptoms are those of gangrenous inflammation and while no tumor can be felt either because of the thickness of the abdominal wall, the location of the gall bladder under the ribs, or the primary rigidity of the abdominal wall yet the sudden subsidence of the local symptoms leads us to suspect gangrene or perforation. Here the clinical appearance does not at all denote the

serious pathological changes but operation is most imperative. Usually gangrenous cholecystitis is readily diagnosed and should always be treated in the same manner as gangrenous appendicitis, acute pancreatitis or strangulated hernia, that is, by immediate operation.

6th. Cases in which sensitiveness to pressure in the gall bladder region persists; not only the sensitiveness felt by the patient but also the increased sensitiveness caused by the examining hand. This is very important. Should operation be advised? Yes. Why? Persistent sensitiveness is the main indication for operation. The area of sensitiveness varies according to the location of the gall bladder. Cases in which the gall bladder can be mapped out and in which not only it is sensitive but the surrounding peritoneum is sensitive and in which the sensitiveness persists are cases of acute purulent cholecystitis. The differentiation between this and perforated duodenal ulcer is largely made on the area of sensitiveness but such a differentiation is not necessary. Both conditions require immediate operative interference.

7th. Cases complaining of continuous pressure in the gall bladder region with a tender gall bladder, the patient not being able to attend to his daily duties and deprived of enjoyment of life through the continuance of the pain. Should operation be done? Yes. Why? Because such a condition is disabling. When we operate we find changes in the gall bladder which can only be corrected by operation.

8th. Cases where jaundice appears, in which there is one chill and rise of temperature but in which a gall bladder tumor is not present and in which sensitiveness is lacking. Should operation be done? No. Why? Because such a condition may be one of simple cholecystitis which may rapidly subside, but if fever and chill recur or if persistent sensitiveness be added operation should be advised at once.

9th. Cases showing enlargement of the liver. This of itself is not an indication for

operation but a liver progressively increasing in size with fever and severe constitutional disturbances, with or without jaundice, in a patient who has a history of gall bladder disease is an indication. These physical signs and symptoms point to suppurative cholangitis, a disease in which medical treatment is only palliative but in which early operation, free drainage of the infection by choledochostomy, is the only means by which life may be saved. To delay is fatal. Medical measures, sodium salicylate combined with urotropin, are helpful as adjuvants to surgery. The subject of enlargement of the liver in relation to gall bladder disease requires more consideration than is allowed for in the time at our disposal.

10th. Cases showing enlargement of the pancreas in the course of gall bladder disease but in which the gall bladder is not palpable. Should such a case be operated upon? Yes. Why? Such a case is either one of acute inflammation of the gall bladder with subsequent involvement of the pancreas through the connecting lymph glands or a case of cholangitis, both conditions which demand operation. It must be remembered that pancreatic involvement occurs in about one-half of the cases of cholangitis and in about ten per cent. of cholecystitis cases, though in the latter the pancreatitis may only be discovered at operation.

11th. Cases presenting jaundice. When is jaundice an indication for operation and when does it contraindicate operation? Patients with jaundice who show a fairly wide spread bleeding under the skin and who show acidosis should not be operated upon without proper medical preparation. Slight jaundice which may be from pressure of lymphatic glands along the common duct or about the head of the pancreas or beneath the liver does not increase the danger of operation. Jaundice caused by chronic closure of the common duct operated upon early does not materially increase the danger. In this class of cases we should not wait until slight jaundice

progresses to severe jaundice with its bad effects upon all tissues and organs including the blood. It is quite important that we operate at the right time. Many cases are brought to us late in the course of their jaundice. It has long been taught that to operate during jaundice is extremely dangerous so that the patient is not apt to consult the surgeon unless urged to do so by his physician, thus delaying operation until it is too late. Unfortunately cases of jaundice are rather difficult to prognosticate. Often catarrhal jaundice with its accompanying gastro-duodenal catarrh and its mucous plug in the common duct is confused with chronic pancreatitis, tumor of the head of the pancreas, a tumor growing retroperitoneally either involving or pressing upon the common duct secondarily or with stone in the common duct. The usual course of catarrhal jaundice is six weeks. Under modern medical treatment (duodenal drainage) the course of the disease is shortened one half. If a case has been diagnosed and is being treated as one of catarrhal jaundice and in which no other diagnosis persists with jaundice beyond the three to six week period it should be operated. Catarrhal jaundice is jaundice free from pain. In such cases duodenal drainage is advisable to shorten the period of the jaundice. When pain is present or when pain has been part of the previous history or when pain develops during the course of the jaundice operation should be done immediately. The earlier the operation is done in the course of the jaundice the safer the operation.

The size of the gall bladder is of value in differentiating between pressure of malignant disease and stone in the common duct as a cause for the jaundice. If we find the gall-bladder distended and jaundice present we make a provisional diagnosis of carcinoma. We are not, however, always able to palpate the gall bladder on account of other factors so that while the presence of a palpable distended gall bladder is of value its absence is not of such important

diagnostic significance. In catarrhal jaundice the gall bladder is flabby and not enlarged.

Frequently jaundice only lasts a few days. In such cases there is history of pain followed by sudden jaundice rapidly clearing up. Here we have to do with a stone which has passed from the gall bladder to the duodenum, though in certain cases it may remain in the common duct quiescent for a while only to cause trouble later. One such attack is not sufficient indication for operation. Frequently such cases go for years without subsequent trouble. When the attacks are repeated and disabling, however, operation should be done.

Before leaving the subject of jaundice let me impress upon you that jaundice is not a necessary symptom of gall bladder disease. The majority of cases never have jaundice. When present, except when evanescent, operation should be done early no matter whether the jaundice is caused by an acute lymphadenitis, by choledochitis, by stone, by sclerotic pancreatitis or by carcinoma of the pancreas or common duct. No matter how skillful we are in diagnosis we cannot always be sure of the exact pathological conditions present and to delay operation in the presence of jaundice, unless the case is one of catarrhal jaundice or familial jaundice or infectious jaundice (Weil's disease) or hemolytic jaundice, is to invite disaster. Jaundice persisting following a slight attack of cholecystitis should be an indication for immediate operation. Jaundice is only one of the symptoms. It may accompany acute cholecystitis as well as chronic cholangitis. The depth of the jaundice is of value in arriving at a probable diagnosis. Jaundice caused by stone is apt to be deeper and more bronze than that caused by pancreatitis which is lighter and more yellowish green. Variable jaundice with a gall bladder which is not palpable makes a diagnosis of intermittent closure of the common duct by movable stone plus inflammation probable. Painful enlargement of the gall bladder with jaundice makes a

diagnosis of cholecystitis with lymphadenitis probable. Painful enlargement of the gall bladder which rapidly disappears suggests a diagnosis of cholecystitis which has drained through the common duct. Jaundice coming on after an acute attack in which the enlargement of the gall bladder persists leads to a diagnosis of an extension to the lymph glands along the common duct. In all these conditions operation is indicated. Allow me to repeat that jaundice is not a contraindication to operation but on the contrary often is an indication for immediate operation.

Given a case in which a tumor is plainly felt in the neighborhood of the gall bladder and in which ascites and deep jaundice are present the probable diagnosis is inoperable carcinoma, yet I have found on exploring such cases that occasionally the physical signs are caused by sclerotic changes in the head of the pancreas with lymphadenitis about the pancreas and along the common duct associated with an old chronic gall bladder with adhesions, the whole pathology being due to gall bladder infection. Such cases should not be denied the chances afforded for their greater comfort by operation, they should have the benefit of an exploration.

Occasionally carcinoma is diagnosed in cases of common duct stone causing intermittent jaundice and finally deep jaundice with cachexia. Such cases should also have the benefit of exploratory operation.

*Conclusions.* If the disease is considered as a focal infection the indications for the removal of such a source of infection are the same as for removal of an infected focus elsewhere i.e., infected teeth, tonsils, appendix, etc. Some physicians, however, think that a fulminating inflammation or a chronic closure of the common duct or a perforation of the gall bladder or a case where the pain is very severe and continuous, that such conditions are the only indications for operation, that is, that there are only three distinct indications. First—empyema; second—closure of the common duct;

third—such cases which in between attacks never feel well. Other surgeons believe that not only cases of the above type should be operated but that practically all cases showing chronic inflammation of the gall bladder should have the gall bladder removed. They believe that the gall bladder should be removed before the inflammation extends to the ducts. In such cases operated early before common duct involvement, the operation is comparatively simple and certainly less dangerous, while if delayed until the common duct is involved the operation is more complicated and certainly more dangerous. Other surgeons and many physicians maintain that early operation is not wise. Be all this as it may there is only one radical cure, that is, removal of the gall bladder and if necessary drainage of the common duct. Removal of the gall bladder, however, is not always possible. The inflammation may be so acute as to render cholecystectomy technically unsafe. This point can only be determined at the operation itself. Cholecystectomy should never be promised before operating upon an acute case. It should be stated that if the gall bladder can safely be removed this will be done. This statement is made here because so many patients now demand removal of their gall bladders believing that even with pathology advanced beyond the gall bladder itself that such an operation is curative. In this they are of course wrong because, while cholecystectomy before the disease has advanced beyond the gall bladder is curative in ninety-four per cent of cases, after the disease has extended outside the gall bladder and involved the common duct, pancreas, liver and neighboring organs through adhesions, and has caused atony of the small and large intestine and a weakened heart muscle through years of chronic infection, as well as impaired kidneys and a host of other nervous infective and metabolic changes, cholecystectomy cannot be followed by a cure of all the complications caused through delay in operating.

# TREATMENT OF ACUTE APPENDICITIS\*

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SO MUCH has been written and preached about the "unnecessarily high death rate" in acute appendicitis being due to the delay of the patients, surgeons have subconsciously adopted the idea that operative mortalities in this disease require no other explanation. The increase of the death rate noted by Eliason and Ferguson<sup>1</sup> cannot be altogether due to the negligence of the public; the propaganda must have had some effect. To castigate the public with the hope of improving conditions is a negative procedure, in fact, it is pharisaical because there still exist surgeons who permit cases of acute appendicitis "to ride" until a time convenient for operation. Amelioration of mortality figures will occur when surgeons, particularly part-time surgeons, realize that even in the complicated cases recovery is the expected outcome.

From many clinics throughout the country there are reported results which show that the mortality rate can be held to a surprisingly low figure. To those who will argue that even this percentage is too high, let it be answered that the death rate in almost every disease is unnecessarily high.

In the last 203 cases<sup>2</sup> operated on in this clinic there were 5 deaths, a mortality rate of 2.5 per cent. Two of the deaths were not directly attributable to this disease: one patient, an appendiceal abscess case of five weeks' duration before admission, died from a severe reaction a few hours after a blood transfusion; the other patient, operated on for a gangrenous appendix, died in diabetic coma. The efficiency of the treatment in this group in reality is represented by the figures of 3 deaths in 201 cases, or a mortality of 1.5 per cent; all 3 deaths occurred from peritonitis. Of the 201 cases, as shown in the accompanying table, there were 33 cases of abscess,<sup>3</sup> 36 cases of peritonitis, 25 cases of gangrene,<sup>4</sup> and 107 markedly acute cases.<sup>5</sup>

Our success is not due to any new technic. There is no new technic, nor modification of technic that remains to be described unless it be along the lines of chemotherapy. We attribute our good results to the observation of the following fundamentals, viz: (1) an operation performed as soon as possible; (2) the use of an incision which does the least damage to anatomical structures and which, in the presence of complications, will (a) give adequate exposure through the smallest wound, (b) reduce the dangers of hernia and (c) prevent contamination of the peritoneal cavity in abscess cases; (3) efficient treatment of the focus of infection; (4) enough drainage material and not too much; (5) detailed postoperative care.

## THE TIME TO OPERATE

In speaking of the necessity for immediate operation in the simple cases (i.e. not abscess or peritonitis), Dr. Ashhurst<sup>6</sup> has stated that "no one can tell from one hour till the next what will happen as long as an acutely inflamed appendix remains within the belly." Amplification of this statement is unnecessary. In this clinic we extend the generally observed rule to include those cases in which there is doubt whether the symptoms are due to appendicitis or salpingitis, in other words, we occasionally operate for diagnosis. If the diagnosis proves to be acute salpingitis, the operative procedures are limited to the appendix.

We feel that abscess cases are as much in need of emergency treatment as the simple cases. It may be true, as stated in a recent textbook of surgery, that 90 per cent of all abscesses will absorb. However, in our experience the walls of many abscesses are made up of coils of intestine glued together by fibrin, a very weak bulwark against peritoneal contamination. Procrastination does not improve

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the patient's condition. Delay does increase the dangers of pyelephlebitis, fecal fistulae and peritonitis.

In peritonitis cases, procrastination assumes an important rôle in the treatment. From the surgeons of the preceding generation it was learned that to operate on the very sick cases meant a frightful mortality and because of this there was developed the treatment with which are associated the names of Fowler, Ochsner, Murphy and Alonzo Clark. Like most other surgeons we depend to a great extent on the condition of the abdomen to determine whether or not a patient requires immediate operation. When rigidity exceeds distention we operate, and when there is decided distention we resort to the expectant treatment. Eight out of the 36 peritonitis cases shown in the table were too ill for operation when admitted; out of this number one died. The one death occurred in a child, which brings up for discussion the rule that all peritonitis cases in children should be operated on because children "stand peritonitis badly." Our experience does not agree with this statement. In the group of 8 already noted, 2 of the recoveries were in children, and furthermore, in the fatal case the peritonitis was subsiding when on the third day the child suddenly became distended, probably due to a re-infection from the rupture of an abscess between intestinal coils.

#### THE INCISION

Thirty-five years ago, McBurney described an incision which seemed to be ideal in that anatomical structures were preserved and that the approach was close to the site of the appendix. Before long it was recognized that the incision offered insufficient exposure for the difficult cases, and as a result there came into existence: (1) Wier's modification, a prolongation inwards from the lower end of the McBurney incision, and (2) Elliot's more direct method of an initial transverse incision.<sup>7</sup> Elliot's incision did not meet with the approval of his confreres, and, like Wier's incision, seems to have fallen

into disuse after the author's death. On October 2, 1905, before the Philadelphia Academy of Surgery G. G. Davis<sup>8</sup> again described the transverse incision with the modification of retraction of the rectus towards the midline: in this communication Davis gives credit to Elliot for the original idea. Subsequently, but before Davis' article was published, A. A. Rockey<sup>9</sup> described the same incision.

The incision is placed transversely at the level of the anterior superior spine with the center over the semilunar line (Fig. 1) and is 5 or 6 cm. in length. The aponeurosis of the external oblique is divided in the same direction as the skin wound (Fig. 2): in this detail the incision is not as ideal as that of McBurney, because it cuts across the fibers of the aponeurosis which run in an oblique direction. At this time it will be noted that the fibers of the aponeurosis pass half way over the rectus before they fuse with the anterior sheath (Fig. 2). After splitting the external oblique muscle, the internal oblique and the anterior sheath of the rectus come into view (Fig. 2). The next step is division of the anterior sheath of the rectus transversely and retracting the rectus muscle towards the midline (Fig. 3). From this point there are two possible variations, viz.: (1) opening the peritoneal cavity in the gap left by the displaced rectus, hooking up the abdominal wall on the left index finger inserted inside the peritoneal cavity and splitting the internal oblique and transversalis muscles transversely outwards with scissors, or, (2) dividing the semilunar line with scalpel and blunt separation of the muscle fibers (Fig. 3). Either one of the variations preserves the nerves which pass transversely inward to the rectus muscle.

I have used this incision for fifteen years or more. Like Rockey,<sup>10</sup> I believe that once this incision has "been understandingly practised" it will never be abandoned. With this approach the incision need not be any longer than the McBurney incision, for difficult cases the incision can be extended inwards or outwards, and in the

event that the diagnosis proves to be a ruptured ovarian cyst, or a twisted cyst, or an intussusception, the condition can be

from unguarded movements. When the incision has been extended to the full length, the abscess cavity lies in plain

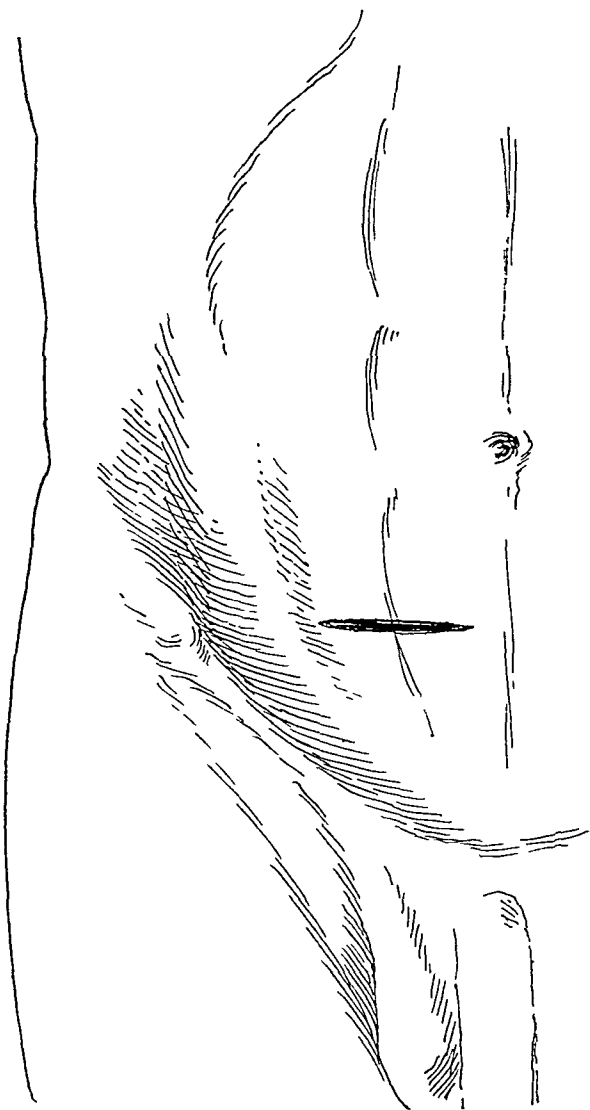


FIG. 1. Transverse incision for appendectomy.

adequately treated through this wound. However, the most decided advantages of the incision are experienced in the treatment of the complicated cases.

In abscess cases the peritoneal cavity can be opened to the inner side of the mass by dividing the peritoneum in the gap left by the displaced rectus, thus at the outset avoiding any contamination of the peritoneal cavity. Through this opening the abscess is surrounded by packs before extending the wound outwards, thereby protecting against any rupture of pus

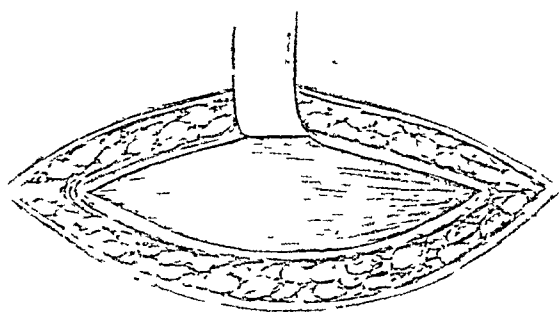


FIG. 2. External oblique divided, exposing internal oblique and anterior sheath of rectus with rectus muscle showing through sheath.

view and in most all of the cases the appendix can be removed without fear of disseminating pus.

In the peritonitis cases the incision need only be 3 or 4 cm. and is placed directly over the appendiceal region. If there be one place that the trite saying "better measure for a belt than a coffin" is not applicable, it is in these peritonitis cases. The larger the wound, the greater are the number of the lymphatics that are opened, and the greater is the absorption of toxins. The larger the wound, the more extensive is the wound infection and again the greater is the absorption of toxins. The proximity of the wound to the appendix nullifies the arguments about the dangers of removal of the appendix in this complication.

In closing the wound, particular attention should be given to the sutures at the semilunar line because this is the weak point in the incision as shown in the diagram attached in Figure 4. Also, the drainage should be taken through the outer angle of the incision for the reason noted. With the latter precaution there will be a lower incidence of herniae because the contractions of the transverse muscles on the walls of the drainage tract have a tendency to close the gap in the tissues.



## TREATMENT OF THE APPENDIX

As has been previously indicated, with the transverse incision and a packing-off

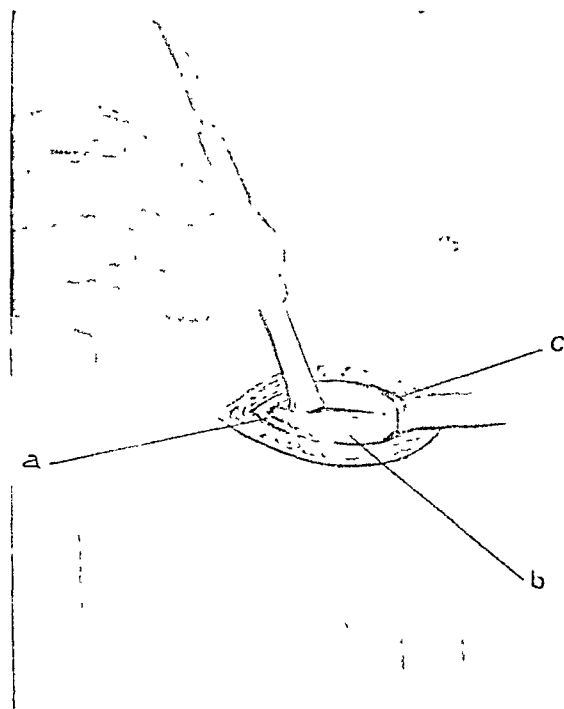


FIG. 3. Internal oblique and transverse muscle being split outwards by handle of scalpel. (A) External oblique (B) internal oblique (C) rectus muscle retracted outwards.

of the abdominal cavity, we have been able to remove the appendix in most of the abscess cases: in the group here reported there were 28 appendectomies (primary) in the 33 cases of abscess. There was not a single fatality in the 33 appendiceal abscesses. No one of the 5 patients who had drainage alone was permitted to leave the hospital until the stump of the appendix was removed. To permit these patients to leave the hospital without a secondary appendectomy frequently means that they will have a prolonged siege of drainage, and subjects them to another attack of appendicitis or to the development of another appendiceal abscess.<sup>11</sup>

The appendix was removed at the primary operation in all 28 cases of peritonitis which were operated on soon after admission. In the 8 cases treated by the expectant method, the appendix was removed in 7 at the time the post-Ochsner abscess

was drained; the one case in which the appendix was not removed was the child who died from a re-infection. It has always

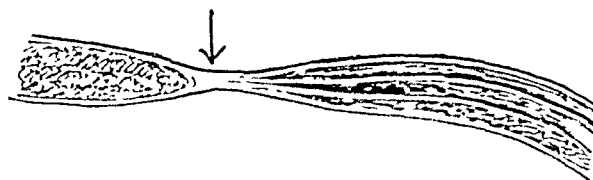


FIG. 4. Diagrammatic cross section of abdominal wall at level of anterior superior spine. Arrow points to semilunar line.

been our belief that drainage alone in these cases is not a sound practice because, if the patient is too ill to resist a procedure which requires only two or three additional minutes, which opens no lymphatics in the appendiceal region, but which does shut off the focus of infection, he is too ill to be exposed to additional absorption of toxins through the lymphatics of the abdominal incision. There were two deaths in the 28 cases we treated in this manner, or a mortality of 7 per cent.

## DRAINAGE

For the abscess cases, and for the cases of extensive gangrene such as the 25 noted in Table I, we use cigarette drains:

TABLE I

	TOTAL CASES—201.	DEATHS—3.	MORTALITY 1.5 PER CENT	
	Cases	Deaths	Mortality, per cent	
Acute appendicitis (simple).....	107	0	0	
Appendicitis with abscess.....	33	0	0	
Appendicitis with peritonitis.....	36	3	8.3	
Appendicitis gangrenous ..	25	0	0	
Total.....	201	3	1.5	

usually two drains for the abscess cases placed in the abscess cavity; and one drain only in the gangrene cases, placed in the pelvis. In the abscess cases, one drain is removed in forty-eight hours; the second drain is shortened on the fourth day and the shortening continued until the seventh

day when the stump of the wick is entirely removed. In the gangrene cases the drain is removed, if there be no infection, in forty-eight or seventy-two hours.

For the peritonitis cases we still use the glass tube which was originally used by Koeberle and modified to the present form by Keith in 1866. This procedure is considered obsolete by most surgeons. To us it still has the advantages that it maintains a rigid canal through which the pus can be aspirated, and, furthermore, it is a signal in our hospital that this patient is very dangerously ill and requires a nurse day and night until the drain is removed. Above all with the glass tube, there is less tendency to the formation of adhesions and the occurrence of postoperative obstruction. The glass tube is passed into the pelvis, and behind the tube there is placed a cigarette drain to the same area in order to make use of capillarity. As soon as the purulent discharge changes to a serous character, or about forty-eight hours after operation, the glass tube and the cigarette drain are replaced by a rubber tube which is shortened on the fourth day and removed on the seventh.

There has been considerable discussion about drainage material being the cause for fecal fistulae, and too much drainage undoubtedly is a cause. We have had a rather high percentage of fistulae, 7 in 94 drained cases, or 7.5 per cent. Everything that had a discharge of thick consistency and a fecal odor we have called a fecal fistula. In only one case was there anything which resembled pure feces.

Of these 7, one was undoubtedly due to drainage that was too much and too prolonged; this was a case of abscess. In the remaining 6 cases, the fistulae appeared the day after operation in one case, in 2 cases on the second day, and in the other 3, the fistulae appeared

on the third, fourth and sixth days respectively. It seems probable that the fistulae which appeared on the first, second, third and fourth days, 5 cases in all, were due to the disease and not to the drainage. Every one of the 7 cases healed without secondary operation. In 3 of the cases the fistula persisted for three weeks, and in the other 4 the discharge persisted for four, seven, eight and thirteen days respectively.

#### POSTOPERATIVE CARE

The treatment that is so well-known is given to the complicated cases. This treatment requires detailed care. In the peritonitis cases, the glass tube is aspirated every twelve hours. Particular attention is given to the enteroclysis to see that there is no sagging of the line between the receptacle and the rectum. Morphine is pushed until the respirations approach the rate of twelve per minute. Water in teaspoonful doses is usually started in thirty-six hours. In the convalescent stage, too much eating is cautioned against, because it sometimes causes an exaggerated peristalsis and a kinking of the intestines.

#### CONCLUSIONS

Brilliancy in operating is not the prime requisite of the treatment of acute appendicitis and its complications. It was to this disease that Warbasse applied the aphorism that "*un bon operateur serait quelquefois un mauvais chirurgien.*" To plan what to do, or rather to know what to plan is essential. The lesson cannot be better emphasized than by the statement of Dr. Ashhurst from the essay, *The Surgeon and the Operator*, a lesson in strategy and tactics, that "no amount of excellence in tactics will repair a fault in strategy." [For references see author's reprints.]

# EXTRA-ARTICULAR ARTHRODESIS OF THE HIP

BY BONE GRAFT, FOR TUBERCULOSIS OF THE HIP\*

FRED H. ALBEE, M.D., SC.D.

NEW YORK

IN THE treatment of tuberculous joints, the fear of spreading the infection and of exposing the diseased tissues to secondary infection prompted surgeons, in the past, to leave the lesion untouched and unexposed and to institute such measures as would ensure immobilization and rest. If, however, the tuberculous tissue can be largely removed, and the bony elements can be coapted over a broad surface, the progressive surgeon no longer hesitates to carry out erosion. In certain joints, notably the knee, radical erosion is carried out because coaptation of the bony elements can be secured and ankylosis brought about. In the spine, the anatomical difficulties of resection in such an inoperable location and the danger of involving the spinal cord in either primary or secondary infection have always argued for conservative methods. In the hip, although resection and intra-articular arthrodesis have produced varying results in the past, such procedures are not well suited to the structure of the joint and the nature of the disease. Since excision of the diseased tissue in the head and acetabulum reduces the size of the one and increases that of the other, the procedure produces a dead space which there are no means of filling. Moreover, the impingement of the great trochanter on the soft parts overlying the rim of the acetabulum prevents telescoping and renders coaptation of the two elements of the joint impossible.

It was a consideration of these facts that led me, in 1910, to attempt immobilization of the spine by surgical measures that neither exposed the tuberculous area nor disturbed the lesion, and, in 1915, to undertake immobilization of the hip by similar means. In 1919, I reported a

method of performing extra-articular arthrodesis of the hip by means of grafts, taken from various autogenous sources, mortised into the bony elements outside the joint.

I recently reported a series of 31 such cases in which the clinical and functional results were satisfactory. A few months after operation the roentgen-rays in all cases showed the grafts firmly in place. Roentgenograms taken several years later revealed marked proliferation of the grafts and showed how firm was the bridging support given to the joint by this method. The average period of observation was six and a half years.

The operation is indicated: (1) when there is constant relapse of the adduction deformity in spite of long periods of conservative treatment; (2) if the adduction deformity recurs following Gant's osteotomy; (3) if the roentgen-ray reveals marked destruction of the head of the acetabulum or both; (4) if there are symptoms of active tuberculosis in adults or older children, even if the destruction of bone is moderate. It is also applicable in certain cases of osteoarthritis.

When destruction of bone has been extensive and spontaneous arthrodesis is prevented by the accumulated caseous material and by the impossibility of spontaneous coaptation of eroded head and acetabulum, as already stated, extra-articular arthrodesis is necessitated, particularly in older children and adults, by the continued deformity, pain and disability. On the day of this writing, I have performed this operation in the case of a woman who has been suffering with tuberculosis of the hip for thirty years. Twenty years ago the attempt to produce ankylosis by an intra-articular operation failed.

\* Read before the Section on Orthopedic Surgery, New York Academy of Medicine, Jan. 18, 1929.

In this case, mutual recession of the two elements of the joint was responsible for the unusually persistent unfavorable condition.

This case also illustrates another strong argument for biological splinting at the joint itself as opposed to the usual mechanical devices. Long-continued bracing results in marked genu valgum or marked laxity of the knee joint with serious loss of function. In this case both these conditions were present, as the result of the action on the knee of two opposing forces; the one, the constant spasm of the adductors and tendency to adduction of the limb; the other, the action of the well-designed brace which opposes the adduction by its pressure on the lower leg. The internal lateral ligament of the knee gives under the prolonged strain and genu valgum results.

The particular method of bringing about arthrodesis depends on the relation of the trochanter to the ilium. When only moderate destruction of bone has occurred, the trochanter is relatively distant; as destruction increases, the trochanter lies more mesially, and may eventually come to impinge on the rim or on the ilium. In the first type of case, bridging with engrafted bone is necessary; in the second, the trochanter may be fixed by a sliding graft from the ilium or may be directly mortised into the ilium. In the first type the grafts for the bridge cannot be obtained in sufficient length and strength from the immediate locality and are taken from the femur or, better, from the tibia. I shall first consider the tibial grafts.

Because of the thinness and elasticity of the bone comprising the outer table of the ilium, a mortise suitable to receive the grafts can be satisfactorily made with a half inch chisel driven through the outer table of the ilium obliquely upwards between it and the inner iliac table with the handle of the chisel in close proximity to the trochanter. With the cutting end of the chisel still in the mortise prepared by it, located 1 inch posterior to the

anterior-superior spine, and 1 inch below the crest of the ilium, the handle is depressed onto the lateral surface of the trochanter at its anterior border, and used as a guide for some cutting tool, such as the scalpel, to mark on the periosteal structures the line where the motor saw is later to prepare a gutter for graft No. 1.

The same preparation is made for graft No. 2, except that the mortise in the ilium made about  $1\frac{1}{2}$  to 2 inches posteriorly to the first one, and the scalpel mark is made on the posterolateral surface of the great trochanter.

Saw cuts are now made  $\frac{1}{2}$  inch in depth with the motor saw, following the scalpel marks just made on the trochanter. With an osteotome driven into these saw cuts, fragments of the trochanter are displaced with the periosteal soft parts as hinges anteriorly from the saw cut for graft No. 1 and posteriorly from the saw cut for graft No. 2, so as to produce gutters to receive the two grafts.

The antero-internal surface of the tibia is then laid bare from the tuberosity of the tibia downward. With the motor twin saw set with the blades at approximately  $\frac{5}{8}$  inch apart, a graft is removed by saw cuts made downward from the tuberosity of the tibia about 9 inches. With a motor saw this strip of bone is then cut into two segments. The upper ends of the grafts are cut in an oblique way like the end of a chisel.

The upper end of graft No. 1 is inserted into the mortise of the ilium with its lower end lying in the anterior gutter prepared in the trochanter. The oblique surface at the upper end is outward. With the author's bone drift or set (of which the carpenter's nail set is the prototype) placed on the trochanteric end of the graft, the graft is now driven into the iliac mortise. In this manner its trochanteric end is made to slide along the trochanter gutter and its proximal end to penetrate the mortise of the ilium by means of blows of the mallet upon the bone set.

Graft No. 2 is put in by precisely the

same technique. The firmer the grafts are driven into the iliac mortise, the closer do they hug the bottom of the trochanteric

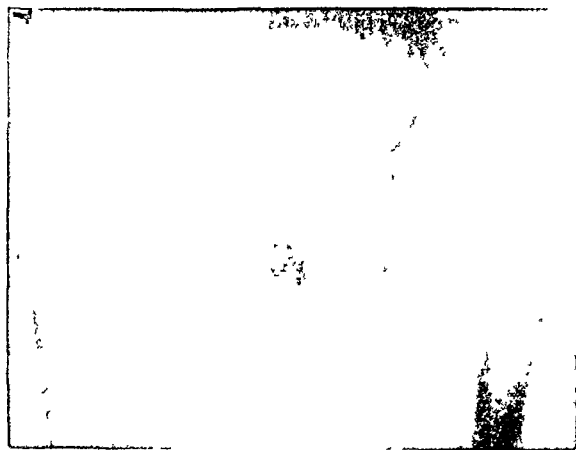


FIG. 1. Tuberculosis of hip before extra-articular arthrodesis.

gutter because of the obliquity of the cut end of the iliac end of the graft. This plan of operation automatically immobilizes the grafts at both ends in a most gratifying way and no immobilizing bone ligatures are necessary.

The soft parts with fragments of the trochanter are drawn over the ends of the graft by means of interrupted strands of medium kangaroo tendon. The gluteal muscles are carefully drawn about the grafts by means of chromic catgut sutures.

The skin is closed with continuous suture of o plain catgut. Suture holes and the edges of the wound are puddled with 3½ per cent tincture of iodine.<sup>1</sup> The results are illustrated (Figs. 1 and 2).

If the graft is taken from the femur, the original incision is extended downward to expose the anterolateral aspect of the femur for 5 inches from the tip of the trochanter. By means of the motor saw and osteotome, a graft is taken from the femur extending from the tip of the trochanter to the inferior limit of the exposure, and including one-fifth of the diameter of the shaft. A pedicle of muscle is left attached at the upper end, and upon this as a hinge the graft is swung anteriorly

and then upward until the free end impinges on the ilium. A suitable site for placement of the graft is now determined, and a flap is raised in the outer table of the ilium to accommodate it. The graft is now pushed backward under the flap.

In neither case are any immobilizing bone ligatures necessary, if the grafts are accurately fitted, so that no foreign material is present to prejudice the "taking" of the graft.

When destruction of bone by the tuberculosis has been extensive, the trochanter may lie so close to the ileum (a half inch or less) that a sliding graft from the outer table of the ileum into the trochanter may be expected to provide adequate fixation of the joint. This procedure is more rapid than the two methods I have just described, largely because the ilium has been exposed in the Smith-Peterson-Sprengel method of approaching the joint and no extra incision is necessary.

In extreme cases, when the trochanter rests against the ilium, direct mortising of the two bones may be undertaken. The trochanter is first denuded of all soft tissue and periosteum both laterally and mesially. A gutter is made for it in the ilium by elevating a portion of the outer table just above the rim of the acetabulum. Abduction of the limb elevates the trochanter into the gutter. It may be necessary to reinforce with a graft obtained higher up on the acetabulum.

Such extreme cases are rare: I have only encountered two. The procedure is not ideal, since the operation is partly intra-articular, and should only be applied in those cases in which the tuberculous tissue has entirely disappeared.

I have thus offered a choice of two operations in each type of case. Which operation is performed depends on the pathological state of the joint and on the surgeon's preference. My own preference, when grafts have to be supplied from elsewhere, is for the tibial graft. It is naturally stronger than one from the upper end of the femur since its cortex is thicker. Since the portion of the tibia from which it is

<sup>1</sup> This operation is illustrated on page 217 of the author's textbook, *Orthopedic and Reconstruction Surgery*, Phila., Saunders, 1919.

taken is subcutaneous, the graft can be more readily and quickly removed, and with much less trauma and shock; the upper end of the femur is buried in thick masses of muscle the deeper of which are firmly attached to the bone. The shock attending an incision through muscular tissue of such depth and extending for 10 or 12 inches distally from the iliac crest is a serious argument against this method. Cannon has drawn attention to the gravity of such procedures. The removal of a section from this part of the bone is not an easy procedure. Moreover, it is desirable to spare the infected joint as much indirect trauma as possible. Since the viability of the graft will depend on the establishment of its circulation in its new position, it is desirable to minimize the disorganization of the circulation of its host and to choose some distant site for the source of the graft. When the graft is taken from the trochanter and swung upwards, the arrangement of the muscles attached to it is disorganized and the muscles themselves partly destroyed. For this reason the possibility of future arthroplasty is seriously jeopardized.

More important, perhaps, than all these reasons for my preference, is the fact that from the tibia sufficient bone can be taken for two grafts. The strength of two grafts supplied to different aspects of the arthrodesis is much more than twice that of one graft, on account of the application of the principle of truss work in structural mechanics. The validity of this argument was illustrated recently in a case in which a good result had apparently been attained with the femoral graft. On being interviewed in the course of the follow-up, the patient stated that she had been confined to bed on account of an attack of severe pain at the site of the operation. After a few weeks' absolute rest, the pain had disappeared. The x-ray now showed that the femoral graft (although as large as was consistent with the safety of the remaining portion of the femur) had broken and reunited during rest in bed. This happy and extraordinary ending does not discount

the danger of furnishing too little support for an arthrodesis which must withstand great strain if it is to function usefully.

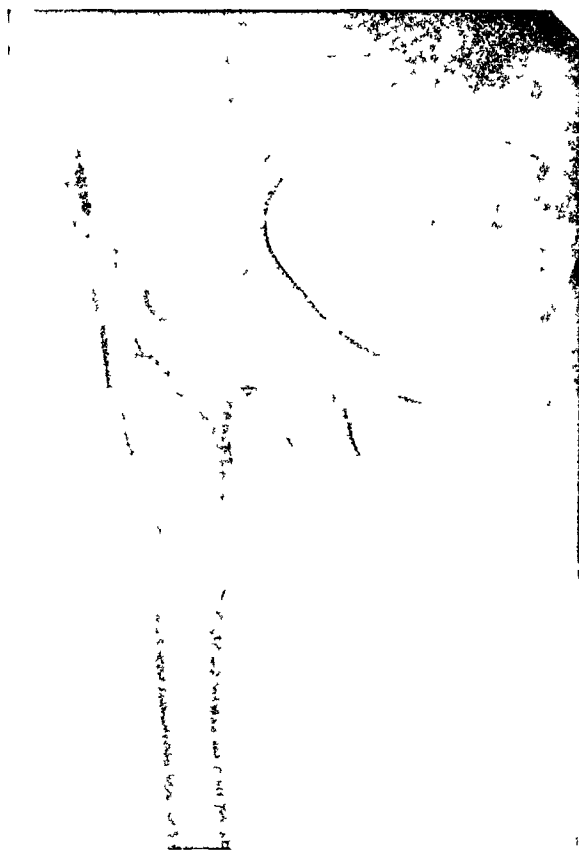


FIG. 2. Same case showing grafts firmly in place. Only one graft shows because both are in same line with roentgen ray.

It is to be noted here that the symptoms were absent until the graft gave way, and disappeared again when the graft united. The use of two tibial grafts has never been followed by fracture in my cases.

The method which I have described for using the femoral graft is a modification of the Hass or Hibbs method. As originally carried out, this method did not appear to be extra-articular, and I varied it so as to keep away from the infected zone. I have described this modification here, with such comment on the operation in general as my experience with it dictates. Whichever of the four methods the surgeon chooses, he will do well to be guided by the desire to avoid infected tissue when possible, and he will naturally prefer the simplest technic and one least likely to be associated with trauma and shock. He

should bear in mind the possibility of future arthroplasty, since arthrodesis may be only half way to the surgical ideal. The difficulty attending such future operation depends considerably on how the arthrodesis was affected. I have had one case for arthroplasty four years after arthrodesis. The tibial grafts had been used for fixation.

The success of these methods depends largely on accuracy of fit of the graft. By means of such accurate tools as the adjustable twin motor saw, the precision of a joiner can be emulated; the dimensions of the graft and its gutter are made to correspond accurately. The graft, when hammered into place and covered with the original soft tissues, will remain in place and the bones will remain in their fixed position if a cast is properly applied. Since the ultimate solidity of the graft is the result of a biological process, nothing should be done to hinder osteogenesis or to weaken the graft. Hence the necessity for avoiding immobilization with non-absorbable foreign material such as wire, screws and boiled-bone pegs, which always have a destructive effect on the host bone. This is of particular importance since osteogenetic power in tuberculous patients may be very low, and should always be considered low when the operation is planned.

The surgeon can no longer get along with an accurate knowledge of anatomy and some dexterity with knife and needle. The general surgeon must have a clear idea of the functions of the parts he is manipulating and of the forces of destruction which he is fighting as well as the forces of repair which he is encouraging. In addition, the orthopedic surgeon must have a keen mechanical sense, a reasonable acquaintance with the laws of mechanics and some experience in the use of tools. One must frankly say that the operating room is not the place, in all fairness, to begin one's acquaintance with saws, chisels and mallets; and a surgeon must be very confident in his inherent mechanical skill if he undertakes delicate work in bone

grafting without ever having done precise mortising in hardwood. It was to assist the precision of bone surgery that I had recourse to such exact instruments as the twin motor-saw and the dowel-shaper. There are surgeons who insist that absolute accuracy can be attained with the osteotome, and others who believe that absolute accuracy is unnecessary. The first might find illumination in a visit to the carpenter's bench; the second, I believe, will not find their contention in harmony with the physiological and biological principles that underlie the union of engrafted bone.

#### DISCUSSION

DR. LEO MAYER: In dealing with children the problems that we find most difficult are: When is an operation indicated? What is the most favorable time? Are you to do an arthrodesis in every case where you are sure tuberculosis is present? Are there certain cases in which there is a chance that cure may occur with function of the joint? And if you do decide that operation is necessary, what is the bet?

Although, in my opinion, arthrodesis is the operation of choice, I would like to urge the bifurcation operation as an alternative procedure in cases of quiescent tuberculosis when there has been extensive destruction of the head. The advantage of the operation is the retention of motion and, at the same time, the production of a stable joint in which the weight of the body pulls on the uninfected femoral shaft. In the two patients upon whom I did this operation, the result has been admirable.

The important question is how soon should the operation be performed and what kind, and which is the most preferable method of approach?

In children suffering from a tuberculous hip, if an immobilizing operation is to be done, which is to act only as a temporary stabilizer would it not be better to insert here an heterogenous graft which would absorb eventually of its own accord, instead of an autogenous graft which requires greater mutilation and a later operation for its removal? Another question is: How long shall the adolescent type be treated conservatively before proceeding to do the extra-articular grafting operation?

DR. KRIDA: I think that most of us are very glad to secure ankylosis in these cases without entertaining the possibility of doing an arthroplasty later. It seems to me that one

very important consideration enters into this: that if we are to be led into doing arthroplasty, after an operation to secure ankylosis, there ought to be a definitely established diagnosis of tuberculosis; we know that some of these joints look in the roentgen x-ray pictures like tuberculosis and they act like tuberculosis, but on section no tuberculosis is found. The argument for arthroplasty will have more weight if a diagnosis of tuberculosis is more definitely established at the time of operation.

DR. WEIGEL: I think we are all agreed that when possible it is best in advanced cases to place our graft in an extra-articular manner as Dr. Albee has described. However, I recently operated upon a case in which there proved to be more destruction than I expected. I had scarce y gone through the skin before I opened into a large abscess which connected directly with the capsule so that any operative procedure would of necessity have been intra-articular rather than extra-articular. Because of the closeness of the great trochanter to the ilium I placed two large grafts taken from the ilium between the great trochanter and the side of the pelvis and closed the wound as usual. It is now almost two months since this patient was operated upon and she is still in plaster, but the wound has remained entirely healed.

DR. ALBEE, *closing*: The question when should we operate children: I think we should select cases principally from the older children and adults. As for selection in the younger children, it is a matter of minute study in cases of long continuance of the tuberculous process. If we have a pathology with a large amount of destruction with recession of the articular surfaces and are certain we are not going to get function and a movable joint, and judge from the pathology that a spontaneous arthrodesis will be long delayed, I think we should do an extra-articular arthrodesis; but if we have any reason to believe we can get a functional result in the child or will get a reasonably early arthrodesis in unfavorable cases without operation, we should not operate. I do not feel as strongly as some of our confreres about operating on all of these cases. I believe we should operate on a large percentage.

Now as to the bifurcation operation, it does not appeal to me very much. I cannot understand the rationale. Here we have a case of active tubercular lesion, with an immense amount of caseous material, and it is undis-

puted that we want immobilization to get healing. If one has a case in which the tuberculosis has healed, and we are sure of it, and there is adduction and we want to increase motion, we might do it instead of an arthroplasty; but in such cases as we are discussing here I do not quite see the rationale of its use.

How long shall we wait in adolescent cases? I believe that in adults we should wait a shorter length of time. It needs less argument to justify an operation on an adolescent than on a child of five or six, and I should put the adolescent in the same category as the adult.

Concerning arthroplasty: I have always championed arthrodesis in such cases but I believe that in a few selected cases one may resort to arthroplasty, providing the time elapsed after the last symptom is sufficiently long and a thorough roentgen-ray examination shows ideal healing at the joint with homogeneous bone structure. I believe the hazard is not too great. Shall we do it? A stiff hip in good posture will give good function. In this family, they wanted it, and they are delighted with it; but I would not have pressed them.

Some one asked about the position of the limb following arthrodesis. That depends on how much shortening exists. The desire is to make up for the shortening in a practical way by putting the limb in a position of sufficient abduction with pelvis. We put it in 10 or 15 degrees of flexion.

I would not consider the grafts Dr. Weigel described as wholly intra-articular. To be sure they did go through the tuberculous area, but they were generously mortised into healthy vascular bone on either side. I have put in a number of grafts through tuberculous areas. In my first book<sup>1</sup> I described an extra-articular arthrodesis of the ankle, which was almost completely disintegrated, and in that case I put in three grafts: one mortised into the internal malleolus and down into the os calcis, one into the same malleolus running forward into the internal cuneiform bone; and the third into the external malleolus down to the cuboid; they grew in and the man had a functional foot, ankylosed stiff, but it overcame the pain and the tuberculosis. All three grafts were well mortised and well contacted with healthy bone on each side of the tuberculous area. I have had similar experiences in the spine where the abscess had penetrated through between the spinous processes.

<sup>1</sup> Bone Graft Surgery, 1915.



# A CUTICULAR SUTURE\*

MICHELE TOMAIUOLI, M.D.

NEW YORK CITY

THE purpose of this cuticular stitch is to cause as small a scar as possible. I have seen used all kinds of

The suture in question in its essential is the one prefixed by the word "mattress." However a marked degree of perfection



FIG. 1. Continuous alternating suture in appendectomy incision.

stitches with varying results as to scar formation, and I came to the conclusion that Halstead's subcuticular suture and Stewart's stitch were by far the best in bringing about a perfect coaptation of the skin edges. But the former cannot be used in drain cases, and the latter requires a great expenditure of time which is detrimental to the patient for undue prolongation of anesthesia adds materially to the postoperative shock.

Now it may or may not be so, but, certainly in the mind of the laity, a scar mirrors the ability of the surgeon in being a skillful operator. And then will not the laity wonder what sort of "butchering" was done "inside" of them if the "outside" shows such a ragged, angry-looking scar, especially when compared to the scar of a more fortunate neighbor?



FIG. 2.

FIG. 2. Continuous alternating suture in pelvic laparotomy.

FIG. 3. Suture in same patient as Figure 2 removed on eighth day following operation.

in its purpose is attained when applied to cuticular incisions with the aid of small pieces of rubber tubings utilized as shown in Figures 1 to 5.

These pieces of rubber tubings,  $\frac{1}{4}$  in. long, can be easily obtained by cutting them from a Dakin tube. Their use, I believe, is original.

The advantages of such a suture become at once manifested when viewing the accompanying photographs and sketches. It can be used as an interrupted or as a continuous suture with the same identical results. And trained hands can make speed with it.

It is of especial advantage wherever the scar may show, and in the flabby, pendulous abdomen of multiparae where, according to my experience, there is an

\* Submitted for publication August 13, 1929.

infallible tendency for the skin edges to overlap when sutured.

The suture in question makes overlapping impossible by the use of the small pieces of rubber tubings whose purpose is twofold: first, to prevent the silk from cutting through the skin, and second to maintain the skin edges everted, thereby assuring a perfect alignment of the cut surfaces.

I want to add that better results will be obtained if the needle be inserted slightly obliquely from without in, and then from within out. This gives the superficial layers of the corium a tendency to remain throughout the healing process in perfect opposition.

#### CONCLUSIONS

1. The author confesses his failure to see in practice anything similar to this, nor in the literature a prior description of the same technic.

2. He believes that a happy medium

has been struck in this suture, in that (a) the result is better and certain; (b) it can be used both as an interrupted and

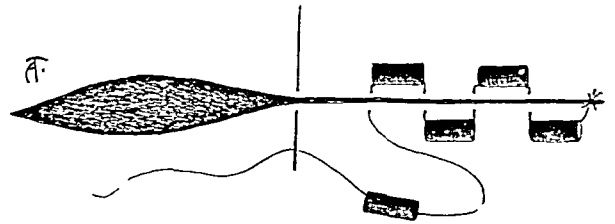


FIG. 4. Schematic drawing of alternating continuous suture.

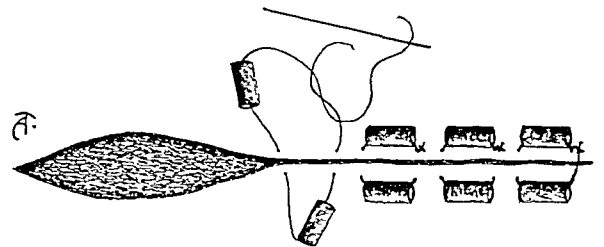


FIG. 5. Schematic drawing of interrupted suture.

continuous suture in drain cases and clean ones with the same identical result, and (c) it can be used without undue expenditure of time.



# TREATMENT OF ACUTE HEAD INJURIES\*

## A FEW CONSIDERATIONS

CARL W. RAND, M.D.

LOS ANGELES, CALIF.

IT IS assumed that the patient is unconscious and has sustained a cerebral concussion, contusion or intracranial hemorrhage. Move as carefully as possible. Elevate the head of the bed, unless the patient is in shock. Place ice-bags to the head, using several to pack the head and give the full benefit of the ice. If the patient does not tolerate ice do not try to force it on him. Quiet is better without ice, than constant resisting with it. Saline cathartic by mouth or rectum may be used. Use morphine as little as possible. Never employ  $\frac{1}{4}$  grain doses and do not leave a "p.r.n." order for the drug. Morphine in large doses is contraindicated for three reasons: (1) it contracts the pupils, covering up inequalities of the pupils which may be present; (2) it tends to mask the symptoms of oncoming stupor which may be due to cerebral edema or hemorrhage; (3) it often fails to quiet the patient, although it depresses the respiration and pulse. If morphine is used small doses are suggested.

A bleeding ear is best treated by placing sterile cotton in the external auditory canal. Cleansing the ear by irrigation of various sorts is contraindicated.

All scalp wounds should be carefully inspected before suture, to make sure whether or not a skull fracture in the vicinity is present.

When cerebrospinal rhinorrhea is present the patient is kept very quiet in bed and told to keep from sneezing, coughing or straining. Traumatic pneumocephalus may occur at times and require removal of air and repair of the torn dura.

Lumbar puncture is recommended for diagnostic purposes in selected cases. It is important to know the character of spinal fluid when considering the possibil-

ity of intracranial hemorrhage. Promiscuous lumbar puncture may be dangerous due to the possibility of medullary herniation in the foramen magnum.

The use of hypertonic glucose (50 per cent), is almost a routine procedure in these cases.

In correcting depressed skull fracture, save the fragments whenever possible.

## DISCUSSION

DR. ALDEN: I do not know of any class of injuries that is so poorly managed by the average physician as acute head injuries.

A few years ago, Sharpe of New York found that the mortality in skull fractures was 50 per cent; that was also true elsewhere. A year or two ago Dr. Rand studied over 180 skull fractures at the Los Angeles General Hospital. He found that formerly the mortality was 50 per cent, the same as Sharpe's, but since special attention has been given the cases the mortality has dropped to 27 per cent. In other words, the treatment of skull fractures by specialists has markedly reduced the mortality. The more we hear from these specialists the better will be the treatment of this class of injury.

One of the things Dr. Rand mentioned was the danger of sewing up a scalp wound with a depressed fracture beneath. If a scalp wound is not large enough to determine the condition of the skull, I make it larger. The size of a scalp wound is of no importance compared with the danger of overlooking a depressed fracture. I think this is very important.

Dr. Rand spoke of the use of saline cathartic. Epsom salts is the best drug that is always available, that you can use in head injuries. Give it by mouth if you can, by rectum if you must, or by vein if you have it in ampules. You can always get Epsom salts. Every country grocery store has it. It reminds me of the automobilist who ran out of oil while touring in the country. He drove up to a farm house and asked if they had any oil. They replied: "No, but we have some Epsom salts."

\* Read before Los Angeles Surgical Society, December 16, 1928.

# SPINAL ANESTHESIA

## LIGHT SPECIFIC GRAVITY ANESTHETIC SOLUTIONS VERSUS HEAVY FURTHER OBSERVATIONS\*

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LAFAYETTE, IND.

IN THE induction of spinal analgesia by subarachnoid block, there are, in general, three principle types of anesthetic solutions used: first, those in which the specific gravity and isotonic properties of the solution are identical, or almost so, with spinal fluid; secondly, those which are lighter in specific gravity than is spinal fluid; and, thirdly, those which are heavier in specific gravity than is spinal fluid. This has been true since almost the very earliest use of spinal anesthesia and continues so today. In a previous manuscript,<sup>6</sup> the writer discussed somewhat at length a number of rather intimate experiences and deductions resulting from an extensive use and an intensive study of Dr. Pitkin's novocaine solution, called spinocain,<sup>5</sup> which is lighter in specific gravity than is spinal fluid. After the lapse of time and the vicissitudes of trial and error, spinocaine having ably demonstrated its controllability and availability in spinal anesthesia, it became apparent that a still greater measure of usefulness and adaptability would be inherent to spinal anesthesia if a solution which was heavier in specific gravity than is spinal fluid also were at hand. Accordingly, there has been developed a solution, for the present called novocaine solution heavy, which differs from regular spinocain in that instead of being a 10 per cent solution of novocaine and being lighter in specific gravity (spinocain), this solution, novocaine solution heavy, is a 40 per cent novocaine solution and is heavier in specific gravity than is spinal fluid. At the same time, novocaine solution heavy maintains the same properties of viscosity and retarded diffusibility as does spinocain. While this relatively new product is as yet not on the market for general distribution, the

writer has been complimented by being favored with a supply of a sufficient quantity for the purpose of making clinical tests and observations; and it is from a close study of his records and the results obtained in using novocaine solution heavy that he wishes herewith to present a few opinions.

The first thing to remember, in considering the employment in spinal anesthesia of these two solutions, is their *difference in specific gravity*. With the *light solution*, the patient's head must be *kept down* in order to avoid blocking the cervical nerve roots and the medulla; with the *heavy solution*, the head must be *kept up* to obtain the same result; i.e. *for spinocain, Trendelenburg position must be favored*; whereas, *with novocaine solution heavy, Fowler's position must be used*. Not only are these points of essential and fundamental interest in the life and welfare of the patient, but they are of practical importance in adapting your anesthesia to suit the needs of the surgery at hand.

Supposing abdominal surgery of a pelvic nature is about to be performed. Naturally, it is easier for the surgeon to work out the pathological problem if the patient is in the Trendelenburg position; because, then, the abdominal contents tend to gravitate out of the way of the surgeon, and a lesser number of packs (or none) need to be used. On the other hand, suppose gastric or gall-bladder surgery is anticipated. In this instance, slight Fowler's position often is an advantage; for, then, the abdominal viscera again fall away from the field of operation. This is a very remarkable and almost marvelous feature in spinal anesthesia; to the uninitiated and uninformed, it is almost unbelievable. Still further, experience and observation

\* Submitted for publication July 8, 1929.

show that a great many patients suffer more or less respiratory embarrassment when placed in the Trendelenburg position; especially is this true of cardiacs, asthmatics, and elderly people in general. For these cases, a slight Fowler's position is much more comfortable and more favorable than is the Trendelenburg. Aside from these factors, there are any number of cases which can be operated in either position to an advantage, as far as the operation itself is concerned, and the problem merely becomes one for the anesthetist to determine just how high he wishes to produce motor or sensory block. It must be apparent, therefore, that once you have perfected your technic in the use of these two solutions of different specific gravity, your ability to harmonize the anesthetic procedures with the surgical problem at hand is markedly enhanced. Greater flexibility of choice is yours.

Now, keep in mind certain anatomical features which inevitably must have a bearing on the selection of the heavy or light solution. First, the anterior nerve roots of the spinal nerves control voluntary motion and the superficial and deep reflexes;<sup>2</sup> hence, when they are affected by your novocaine solution, you have muscular paralysis and muscular relaxation, *motor block*. Secondly, the posterior roots of the spinal nerves are sensory;<sup>2</sup> they control pain, tactile, temperature, and muscle sense; accordingly, when these are affected by your novocaine solution to a sufficient degree, all sensations of pain, touch, and temperature are lost, *sensory block*.

Accordingly, to visualize what is about to occur when these solutions of different specific gravity are injected into the spinal canal, perform a little experiment as shown in Figure 1.

Take an ordinary test tube, fill it half and half with two solutions of different specific gravity, such as water and ether, stopping the tube at the top. Now imagine this test tube as representing the human spinal canal,

with the stopper being at the head. Hold the test tube vertical in such a position as shown in Figure 1, A. Your water, being heavier than ether, is at the bottom; the ether, being lighter than the water, is at the top. Now, hold the test tube in 15° Trendelenburg position, as shown at B. The ether, being lighter in specific gravity, rises toward the opposite end of the tube from the head (cork or stopper). This is what results when regular spinocain is injected into the spinal canal, ether representing the lighter specific gravity anesthetic solution, water the spinal fluid. Now, hold the test tube in position C, 15° Fowler's position. Here an opposite effect is obtained. The water, being heavier than the ether, gravitates toward the bottom of the tube. The water now represents a heavy anesthetic solution; the ether, in this case, represents spinal fluid.

Let us imagine that these two test tubes are lying on an operating table, placed respectively in Trendelenburg and Fowler's positions. It must at once be clear to you that, with light solution and position B, the anterior nerve roots will be affected higher up along the cord than are the posterior roots; vice versa, with heavy solution and position C, the posterior nerve roots will be affected higher up on the cord than are the anterior roots. In other words: with spinocain, motor block (paralysis and muscular relaxation) extends higher on the body than does sensory block; with novocaine solution heavy, sensory block extends higher than does motor block.

It is of extreme importance for you to be able to visualize these factors, as they have a bearing of great moment in the conduct of your anesthesia and its adaptation to the patient and surgery at hand.

Now let us transpose the findings with the test tube in Figure 1 to the human spine, as pictured in Figure 2. At A, the light solution, spinocain, is represented within the spinal canal. At B, novocaine solution heavy is shown within the spinal canal. By comparison, we find at A the sensory roots are paralyzed as high as the second dorsal vertebra while the motor roots are paralyzed two or three sections

higher, the sixth cervical. On the other hand, at B, with novocaine solution heavy, we observe that the sensory roots are

fixed in your mind, it must be apparent that when using spinocain, the light solution, motor paralysis occurs several seg-

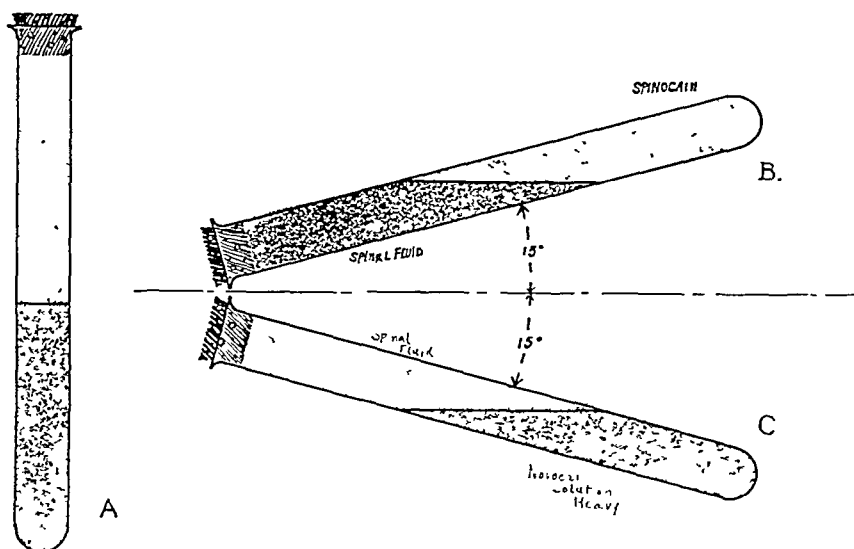


FIG. 1.

paralyzed to the seventh cervical vertebra, while the motor roots are paralyzed only to the third dorsal vertebra.

In the illustration of these two spines, A showing light anesthetic solution and B showing heavy anesthetic solution, is exemplified the highest level of spinal anesthesia which is warranted for any type of surgery, if you are at all interested in the welfare of your patient; and, most emphatically, this height should not be attempted by amateurs. Experience first must be gained in lower types of anesthesia and surgery. However, it can readily be determined that the diaphragm, receiving its motor nerve supply from the third, fourth, and fifth cervical segments of the cord, is not paralyzed, even though sensory anesthesia extends above the nipple line. The abdominal muscles and accessory respiratory muscles indeed are blocked, but observation of the epigastrium will show movement there transmitted to it by the diaphragm. With the lower levels of anesthesia, comparing the two solutions of different gravity, the same relative difference in the sensory and the motor block obtains.

With Figures 1 and 2 thoroughly

ments of the cord higher than does sensory paralysis; and, when novocaine solution heavy is used, sensory paralysis extends several segments of the cord higher than does motor paralysis. Reasoning further, with the light solution, maximum loss of muscle movement and resultant relaxation occurs at the expense of a somewhat lessened extension of loss of pain sense; whereas, when novocaine solution heavy is used, loss of pain sense extends higher than does loss of muscle tone and relaxation. These factors are of extreme importance for you in determining which solution to use in adapting your anesthesia to any particular type of surgery, and there is no place in the recent literature on spinal anesthesia where this feature previously has been pointed out. It helps you to determine, by understanding these factors, how high you should ascend with your block (sensory or motor) to produce any desired or required result. It permits the spinal anesthetist to conform and attune the anesthesia in proper proportions to meet any surgical dilemma.

Still further, the illustrations explain to you the point previously mentioned as to why cardiac, asthmatic, and elderly

people in general do somewhat better under spinal anesthesia induced with the novocaine solution heavy than they also diffusion, i.e. the amount of spinal fluid used to expand the original solution which tends to render it more nearly

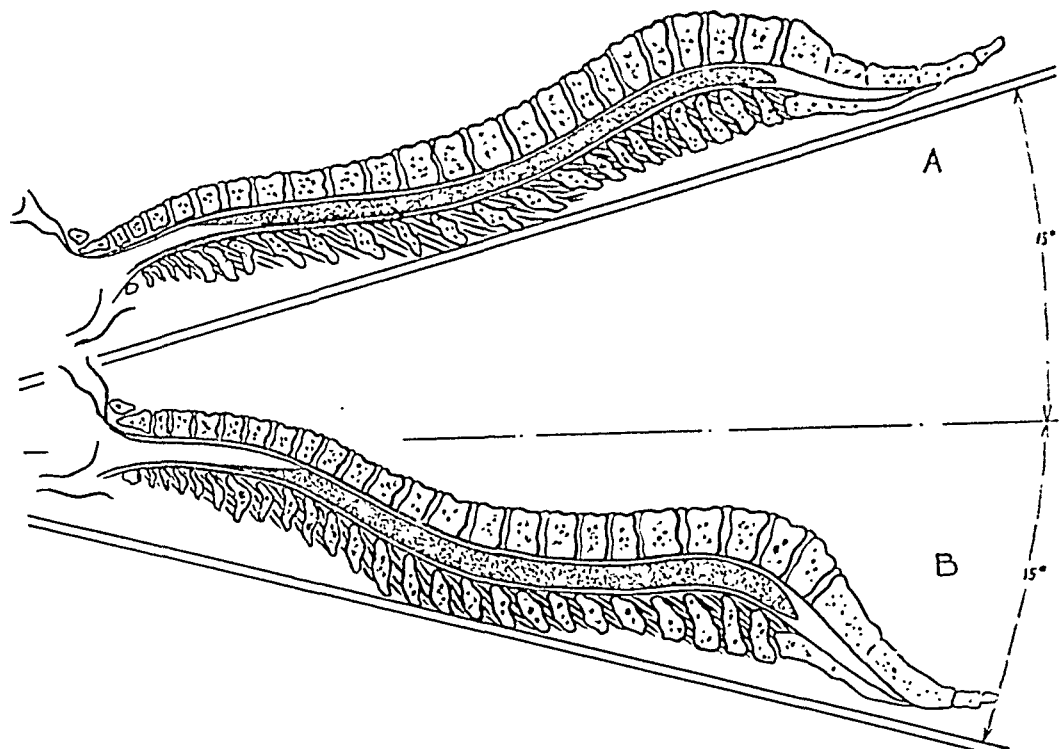


FIG. 2.

do when the light solution is used. Translating the findings to the anatomy involved, you find that while sensory block may extend as high as the clavicles, motor block may not involve even the loss of all of the intercostal respiratory muscles. Of course, the extension of your block will vary a great deal, also, depending on the dosage of novocaine used and the amount of expansion with spinal fluid, as your previous experiences with spinocain will have taught you; yet, if your observation parallels mine, it will be almost immediately apparent to you that the excursion of the diaphragm and accessory respiratory muscles is much more free when novocaine solution heavy is used in spinal block, even for abdominal surgery, than when the light solution, spinocain, is used. It must be borne in mind that the illustrations are diagrammatic; the factor of capillarity enters into the problem,

the same in specific gravity and isotonic properties.

With different classes of patients, some of which just have been mentioned, one must be extremely careful not to embarrass their respiratory apparatus even to the slightest degree; and, for this reason, novocaine solution heavy produces such happy results that one cannot always agree with Labat<sup>4</sup> and others who claim that to use an anesthetic solution in spinal block which precludes the use of the Trendelenburg position, is to invite disaster. Rather, experience has proved quite conclusively that a slight Fowler's position, even at times as much as 15°, *produced under properly supervised expert technic and close observation*, may be employed to very great advantage.

If ephedrine is used in proper amounts, as pointed out in a previous manuscript on this subject,<sup>6</sup> these patients do not have

pallor, sweats or cyanosis. Their blood pressure, pulse and color run along very normally. In fact, it is quite easy to make them appear much pinker in the lips and to increase their blood pressure above normal. Experience has proved ephedrine so superior to adrenalin in spinal anesthesia that there is no comparison. There are those that claim that ephedrine is without effect;<sup>3</sup> surely they are not giving enough; they are over-cautious as to dosage. To piddle along with a dose of 50 mg. is indeed trifling; routinely administer 100 mg. and do not hesitate to use 150 mg. if indicated. These doses are well within the minimum limits of toxicity and produce no discomfort or disagreeable sequelae. The maximum safe dose of ephedrine is given by Solis-Cohen as 5 gm. or 5000 mg.<sup>5</sup> For every authority which can be quoted saying that ephedrine is without effect, it is possible to quote an equally weighty authority who claims and proves that adrenalin is entirely without benefit in spinal anesthesia unless given intravenously, and, even then, the effect lasting only a few minutes. Be that controversy as it may, this most certainly is true: To get any response whatsoever from ephedrine or adrenalin, the calculated dose of drug must be given before the block is established,<sup>5</sup> i.e. before splanchnic paralysis has occurred; otherwise you court disaster. With proper technic in the use of ephedrine in spinal anesthesia, the so called "dry wounds" (i.e. low blood pressure) are not seen; the arteries and arterioles spurt vigorously; some surgeons say more vigorously than with ether, certainly more than with gas-oxygen.

Naturally, of course, coming back once again to a discussion of the position of the table, after twenty or thirty minutes have elapsed and the anesthesia has become fixed, should occasion arise, Fowler's position may be lessened even to the point of making the table level, if it will add to the patient's comfort or to the convenience of the surgeon. This latter fact also applies to the use of

spinocain (light) after the solution becomes fixed, certainly after thirty minutes or more; then, the degree of Trendelenburg position may be lessened until the patient is almost or entirely level without fear of extension of the block.

Aside from all the aforementioned factors, there are many instances favorable to the use of novocaine solution heavy. For example, by no other means in spinal anesthesia, i.e. intradural block, can the effect of your anesthetic agent be limited strictly to the perineum, the so-called saddle anesthesia; and, further, there is no other method by which the relative height of sensory anesthesia and motor paralysis (relaxation) can be regulated with such a degree of nicety and accuracy as by a thorough understanding and a proper technic in administering solutions of light and heavy specific gravity. It gives the spinal anesthetist an almost unlimited number of variations by which he can adapt the anesthesia to the needs of the patient and the requirements of the surgery at hand.

Novocaine solution heavy also is susceptible of very fine regulation as to your constant percentage factor, something discussed in a previous manuscript. Spinocain (light) as now on the market, is a 10 per cent solution of novocaine; in other words, one 2 c.c. ampoule contains 200 mg., and two such ampoules, totaling 4 c.c. of spinocain, contain 400 mg. of novocaine. Four cubic centimeters of spinocain expanded to a total of 8 c.c. (and this should be your maximum dose for a first injection under any circumstances) gives you the constant percentage factor of 5. Novocaine solution heavy, as used for clinical study, is a 40 per cent solution of novocaine, and at present is put up in 0.5 c.c. ampoules. One-half cubic centimeter, therefore, contains 200 mg. of novocaine, and 1 c.c. full contains 400 mg. Referring now again to Figure 1 (or Figure 2), it must be apparent to you that a lesser amount of spinal fluid (or total of expansion) must be used to obtain equivalent sensory block when



using the heavy solution than when using the light. Eight cubic centimeters total expansion of spinocain, whatever your constant factor may be, will be required to give you sensory anesthesia, by proper regulation of your Trendelenburg position, to a point somewhere between the nipples and clavicles, in average cases. Five cubic centimeters total expansion of the novocaine solution heavy will carry your sensory anesthesia to the clavicles, or even to the neck. Four cubic centimeters total expansion of the heavy solution, irrespective of whether 0.5 or a full cubic centimeter of novocaine solution heavy is used, has been my maximum expansion. For routine use, it is preferable to regulate the height of the sensory and motor block by variations in the degree of Fowler's position. What constant percentage factor to use for different surgery must be worked out by each individual spinal anesthetist, as his experience enlarges. Start with minimum doses and minimum expansion and gradually develop your strategy until you can finesse each case at will, i.e. use maximum dosages with minimum expansion or minimum amounts with maximum expansion. You soon will learn how to secure prolonged anesthesia (even up to three hours if needed) by variation of the percentage factor.

For emphasis, it is well to repeat: Where spinocain is used, maintain Trendelenburg position until your solution becomes fixed; where novocaine solution heavy is used, keep the patient in Fowler's position until the solution becomes fixed. If you cannot comprehend the simple facts contained in this one paragraph, then *stay away from spinal anesthesia, or someone will pay with their life through your lack of understanding of these basic and elemental fundamentals.*

With a constantly enlarging experience in spinal anesthesia, the writer is more and more firmly convinced that, to obtain uniformly optimum results in the block, uniform or corresponding percentages of novocaine must be injected into the sub-

arachnoid space. Given patients of equal size and weight and volume of spinal canal, a fixed coefficient or a constant percentage of novocaine produces anesthesia of a given degree and intensity (lasting ability). Increase your novocaine percentage by one-half (i.e. from 5 to 7.5) and you will double the length of anesthesia; double the percentage (i.e. 5 to 10) and the anesthesia will last four times as long. This can be demonstrated to anyone's complete satisfaction, with both the light and the heavy solutions. It is one of the main reasons for the superiority of the Pitkin technic; because, with it, large enough amounts of novocaine can be used to satisfactorily block the patient for even the most prolonged surgery. "It has been definitely proved that amyloprolamine and propantriol not only produce viscous solutions that prevent dissemination and mixing with the spinal fluid, but they also reduce the toxicity of novocaine, permitting three and four times as much to be used without harm."<sup>5</sup> This factor is of extreme importance for the spinal anesthetist who is inducing subarachnoid block for the "other fellow." You do not know how long he may operate, a point stressed in a previous contribution.<sup>6</sup> Strange as it may seem and simple as it appears, most surgeons are not familiar with, or do not care to use, field-block; consequently, if your spinal anesthesia does not last *long enough* and supplemental local or adjunctive gas-oxygen is needed, upon you will fall the odium of failure and thus cast reflection upon spinal anesthesia. Labat<sup>4</sup> and Evans<sup>3</sup> give the operating time available under spinal anesthesia, where 100 mg. to 120 mg. of novocaine are dissolved in spinal fluid, as from three-fourths to one and one-half hours, with an average of one hour. With spinocain or novocaine solution heavy, 400 mg. to 600 mg. of novocaine can be used when needed; and, as already reported<sup>6</sup> there is a record of one patient where 1200 mg. was injected without toxic effect. Also, many records exist of cases

where the surgery lasted considerably over two hours without supplemental anesthesia. However, *do not attempt these dosages until you have perfected your technic and judgment by a study of your previous cases.*

In analyzing my personal records, it is found that in the first series of cases the light specific gravity solution was used in 76 per cent of the cases and the heavy solution in 24 per cent; in the second series, the light solution was employed in 48 per cent and the heavy in 52 per cent. This is due to the fact that one constantly learns a fuller and more complete expression of the benefits to be derived from the use of novocaine solution heavy. Naturally, it is the solution *par excellence* for all strictly rectal surgery, vaginal and perineal surgery, and surgery on the lower limbs. An hour of complete anesthesia can be obtained with the very minimum doses of novocaine (a very small percentage factor) and the anesthesia can be limited in its extent to a nicety almost beyond belief. Novocaine solution heavy also is preferable in all obstetric surgery and manipulations with the exception, possibly, of cesarian section. Hernias, especially in elderly individuals, and prostatectomies best are handled with the heavy solution. With perineal and cervical repair work, plus laparotomy for uterine suspension and appendectomy, use heavy solution with a high constant percentage factor; keep the patient in 15° Fowler's position for the repair work, then level the trunk but bend up the head and neck (from second dorsal vertebra) for the abdominal part. This will give anesthesia long enough and at the same time not interfere with the surgeon. For gall-bladder surgery, gastric surgery, and appendectomy, take your choice, remembering that with the light solution motor block is higher than sensory block and with the heavy solution vice versa. For hysterectomy and pelvic surgery, use the light solution with a high constant percentage factor and close observation of degree of Trendelenburg position.

This only too brief discussion of the possibilities inherent to the use of solutions of different specific gravity in spinal anesthesia gives you an idea of the almost *infinite adaptations* at your command. Many others will occur to you as you advance in knowledge and experience. *Study and analyze each succeeding case.* As in general anesthesia, well known to all, no two individuals react exactly alike to the anesthetic agent, even though the basic fundamentals remain the same, so too in spinal anesthesia. Perfection in technic alone is not sufficient; judgment must be used. Judgment is the sum of knowledge plus experience. Knowledge alone leaves something wanting; experience, without study and analysis to acquire knowledge, also will display a certain lack. The two, knowledge plus experience, must be added to formulate judgment.

In a previous discussion of spinal anesthesia the writer pointed out the advisability of boiling everything (needles, syringes, ampoules, etc.) as an adjunct to aseptic technic. The general surgeons usually are content when they can keep their incidence of infection in clean cases down to as low as 3 per cent (records from good hospitals), but let the spinal anesthesiologist approach a degree of even 0.1 to 0.2 per cent and he would have to leave the city. *It just dare not be done!* At present, two parallel series are being run; at one hospital, everything is boiled twenty minutes; at another, everything is autoclaved ten minutes at 250°F. and 15 lb. pressure. Both methods seem equally effective; the latter is a little less "messy."

In conclusion, the writer wishes to depart from the formality of the manuscript to state that in a period covering ten years of active general medical and surgical practice, plus an additional period of ten years of exclusive devotion to the art and specialty of anesthesia, he has found nothing in these two decades which has provided him with the mental stimulation and brain cell exhilaration which has resulted from the study of and experience in spinal anesthesia. [NOTE: For references see author's reprints.]

# HYPERTONIC SALINE SOLUTIONS IN INFECTIONS\*

KEMP P. NEAL, M.D.

RALEIGH, N. C.

SINCE the days of Lister many have been the bactericides used in combating sepsis. Many have been tried and discarded for newer ones. Each year brings a new one claiming special advantages over all previous ones.

There are many chemicals that are capable of killing bacteria in situ or test tube, but the great objection to most of them has been, and still is, that they also kill or destroy cellular tissue. Any agent which has enough potency to kill bacteria will very often kill the cells in and around which the bacteria are growing and giving off their toxins. There does not seem to be any question about the fact that many of the present day antiseptic agents definitely injure tissues. Personally I have noticed, since the advent of mercurochrome, that fresh lacerated wounds, potentially infected, heal by first intention more often by using this agent than when the time-honored tincture of iodine is used. Many of these agents tend to coagulate blood or lymph or protoplasm, forming an impenetrable membrane over the deeper tissues. Some are rendered practically inert by precipitation by the salt in blood and lymph.

Many of these objections have been met by a newly discovered agent, S. T. 37, introduced by Dr. Leonard. It is claimed that this agent has the special virtue of having a very high phenol coefficient, being non-injurious to tissue, and having a special faculty of penetrating deeply into tissue because of its low surface tension. I wonder just how deeply it will penetrate. It requires quite a play of the imagination to think of a substance finding its way through cell after cell or between cells, reaching the depths of tissue where the most serious part of

the infectious processes is taking place. Any infection which is near the surface or on the surface is rather easily reached and combated. It is the deep-seated ones that give us most concern. Here the organisms are many, many cells away from our antiseptic agent, often separated by an area of infiltration, edema and congestion which add to the difficulty of reaching them.

Remembering the principles of physiology and physics with reference to tissue fluids, blood, and lymph as demonstrated by osmosis, diffusion and dialysis, thought was directed toward these principles in an effort to find an agent which would help rid tissue of infected material. For a hasty review of these principles allow me to illustrate the physical laws of osmosis, diffusion and dialysis which play such an important part in the methods of combating infection to be discussed.

If a solution of salt, and water in which there is no salt, are separated by a membrane which is permeable to the molecules of salt and water, water molecules will flow through the interspaces of the membrane to the salt solution, thereby raising the level of the latter. This response to the difference in concentration of fluids separated by a membrane is osmosis, and the pressure exerted against the membrane is osmotic pressure. Now if white of egg and salt be in the solution placed on one side of a membrane, and plain water in the other, there will be a passage of salt molecules over to the water, but none of the egg. This process in which salts which are diffusible separate themselves from substances which cannot accompany them through a membrane is dialysis. Diffusion on the other hand is simply a mixing of molecules of two solutions or gases when

\* Submitted for publication August 20, 1929.

brought into contact, i.e., the spreading or scattering of molecules through agreeable media.

When two solutions of saline of different strength are separated by a membrane, there will be a flow of water molecules from the weaker to the stronger solution until there is an equality of osmotic pressure on the two sides of the membrane, or as much salt on one side as the other. In nature these same laws are at work, the protoplasm of the cells representing the solutions and the cell walls representing the membranes. There are continuous differences of concentration in body fluids in different localities and under different circumstances, in carrying out nature's processes of metabolism. If one cell has a higher concentration than its neighbor there is a tendency for the weaker to give up some of its fluid to the stronger in an attempt to equalize the two.

It is unquestionably true that physico-chemical processes occurring in the protoplasm of the cell change the permeability at different times and under different conditions. It is equally true that these processes already described are only true for crystalline substances which are soluble in water, and do not hold true for colloids which are only slightly diffusible, if at all. Hemoglobin is an exception to this; it is crystalline and diffusible.

Suppose we surround living cells with a hypertonic solution of salt in situ, what will happen? There will be a flow of tissue fluid, serum and lymph, from the cells nearest the solution into it, in an attempt to reduce its strength to that of the cells themselves. The cells farther away from the solution will feel the effect of this change in osmotic pressure, and there will be an effort to stabilize the osmotic pressure of the tissues for a considerable distance away, the result being a passing of toxin-laden lymph and intercellular fluid into the solution. This process results in a milking of the tissues of their septic content, at the same time relieving congestion, reestablishing flow of blood through

the tissues, aiding in phagocytosis and stimulating repair.

All of these surmises presuppose, of course, free incision and drainage, a thing most important in treating any form of sepsis. One cannot hope to get drainage without it, and it is specially important in this form of treatment. The gross pus, fibrin, and dead and sloughing tissue will be softened and drawn into the saline solution first by the process of diffusion. Then will follow a milking of the intercellular spaces where the active inflammatory process is going on. Pus bacteria, toxic lymph and serum will all pass out into the solution.

As said before, it is not necessary to kill the bacteria if they can be gotten out of the tissues.

The hypertonic solution of sodium chloride or magnesium sulphate should not be too strong. It is an open question which is better. For practical purposes, about  $1\frac{1}{2}$  or 2 teaspoonfuls to the pint of hot water is sufficient. If the solution be too strong it may conceivably, and I believe it does, damage cells, by the excessive differences in osmotic pressure.

As for the practical application of this principle of treating sepsis in tissue, the following facts have been found important: First, as to the types of infections that lend themselves best to this treatment, we have found acute streptococcic infections, as lymphangitis, or cellulitis, specially benefited by the treatment. If it be an extremity where soaking is practical, the whole foot is immersed in the hot saline. If it be on a part of the body where this is impossible, hot wet saline compresses are used.

Deep-seated infections where drainage has been established seem to respond nicely to this treatment. Many times in these infections instead of using rubber tubes or tissue for drainage we have used vaseline or dry gauze for drainage, hoping to get the benefit of capillary attraction in aiding drainage toward the surface, remembering nature's lead of trying to throw

off foreign bodies from tissues by reversal of lymph and producing watery suppurating discharge.

In closed or semiclosed cavities this principle of treatment works admirably. Some of you are familiar with the newer closed methods of treating empyema. By using normal or hypertonic salt solution empyema cavities by these methods are rapidly cleansed of pus, fibrin, and rendered sterile in a few days.

I am sure most of us have used hot saline solution for irrigations and gargles. The principle applies here certainly. Not only by osmosis, but by stimulation of mucous glands about the nose and throat by the hypertonic solution, is drainage and relief of congestion obtained.

More recently I have used the idea in irrigating bladders and posterior urethras for prostatic inflammation or abscess formation with amazing results.

We have formed the habit of using stronger solutions for treatment of unopened, deep-seated infections, as in adenitis, synovitis, tenosynovitis, or even arthritis, with good results. I do not mean to convey the idea that there will be drainage through unopened skin in these cases, but the result does seem to be more effective by using saline soaks than by simply using hot water. It does seem to

hasten pus localization in case the infection is going to lead to this, or absorption of inflammatory products in case the infection is not going to localize, but disappear.

The time element also seems important. The soaking or application of compresses should be kept up for at least one-half to one hour, and repeated twice or three times a day.

To summarize: There has always been a vain search for an agent which would be an ideal germicide in treating infections. Many useful ones have been found but all have their objectionable points. Remembering nature's laws of osmosis, dialysis and diffusion, and how important a part inorganic salts play in the life of cells in regulating the osmotic pressure of the cell fluid and intercellular fluid, it seems logical to conclude that using hypertonic salt solution as a soak, irrigation, or compress for infected tissue will result in a reversal of flow of tissue fluids into the solution, thereby ridding the tissue of bacteria and their liberated toxins, as well as relieving congestion and aiding healing. This has been found true clinically.

This method is not offered as a panacea for all infectious processes, but seems to offer many advantages over the use of antiseptics.



# SHOULDER PAIN\*

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IN order to reach an understanding of the various lesions responsible for shoulder pain, some conception of the anatomy and physiology of the shoulder joint is essential.

I propose to review some of its anatomic features, using specimens recently prepared in the department of anatomy at Columbia University.

The shoulder joint is an enarthrodial diarthrosis, or ball-and-socket joint, with motion in three planes at right angles to each other. The articulating surfaces are the rounded head of the humerus and the shallow pyriform glenoid fossa of the scapula. At first sight one can readily appreciate the fact that the glenoid fossa does not accommodate or embrace the humeral head and the joint is therefore not a stable one by its conformation. The capsule is a loose structure attached around the circumference of the glenoid and the anatomical neck of the humerus. In a macerated preparation there is considerable play between articular surfaces owing to the length of the capsule. The ligaments of any joint are merely thickenings or reinforcements of the capsule in response to stress and strain. The capsule of the shoulder joint is reenforced in front by the three gleno-humeral ligaments because the greatest strain is placed upon the capsule by hyperextension of the arm. The capsule is further strengthened by the coracohumeral ligament which extends from the base of the coracoid process of the scapula to the greater tuberosity of the humerus.

The two projecting bony processes of the scapula, the coracoid and acromion, connected by the coracoacromial ligament serve as an extra socket for the head of the humerus. They tend to protect the joint from minor injuries and in a measure

keep the deltoid muscle off the capsule. (See Figs. 1-4.)

## MUSCLES

The joint is surrounded by powerful muscles whose balanced tone keeps the articular surfaces in contact. One has only to observe a shoulder joint affected by poliomyelitis, with the humeral head falling well below the acromion process, to appreciate this action of the musculature in stabilizing the joint. Of the muscles acting on the shoulder joint we recognize six groups by their action; there is, of course, some overlapping of function in certain muscles:

1. Abductors: deltoid and supraspinatus.
2. Adductors: pectoralis major, teres major, latissimus dorsi, etc.
3. Medial rotators: subscapularis, etc.
4. Lateral rotators: infraspinatus and teres minor.
5. Flexors or protractors: pectoralis major, biceps, coracobrachialis, serratus anterior, etc.
6. Extensors or retractors: latissimus dorsi, teres minor and infraspinatus.

It is, however, a great mistake to award to one muscle a single isolated action. The cortex thinks in terms of an action, not in terms of this or that muscle or group of muscles, and, the action being determined, a group of muscles is summoned for its fulfilment.

The relation of the long head of the biceps to the shoulder joint should be noted. It passes as a rounded tendon through the intertubercular groove beneath the transverse humeral ligament across the joint to insert into the supraglenoid tubercle. It is invested with synovial membrane. From its situation it acts to prevent the humeral head from being displaced either upward or downward.

\* From the clinic of the New York Orthopaedic Dispensary and Hospital. Read before the Clinical Congress of the Connecticut State Medical Society, Sept. 1928.

Injury to this tendon is occasionally the cause of a disability in a baseball pitcher.



FIG. 1. Shallow pyriform glenoid fossa of scapula with tendon of long head of biceps attached to supraglenoid tubercle above and long head of triceps attached below. Deltoid attached to acromion and clavicle is reflected, showing supraspinatus muscle directly over glenoid fossa.

## MOTION AT THE SHOULDER JOINT

The shoulder joint is extremely dependent on other joints for its motion. The

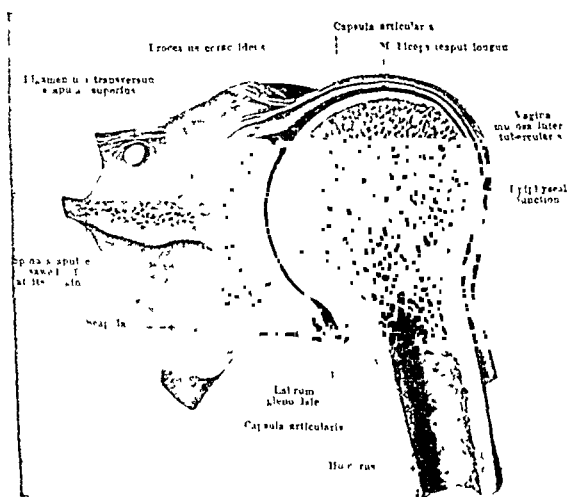


FIG. 2. Small shallow glenoid fossa in relation to rather large rounded humeral head. Tendon of long head of biceps is shown in relation to glenoid and humeral head. (From Spalteholz.)

scapula takes part in almost all its motions, sharing in it from the start and not waiting

until the full range of shoulder joint is accomplished.

Adduction with the arm hanging at the



FIG. 3. Capsule of shoulder joint from front. Its attachment to circumference of glenoid and to anatomical neck of humerus may be seen. Extra socket formed by coracoid and acromion processes of scapula connected by coracoacromial ligament is shown. Coracoclavicular ligament with its conoid and trapezoid elements is also clearly seen.

side is not free apart from the presence of the body.

Abduction is possible to  $90^\circ$  before the



FIG. 4. Window cut in capsule of shoulder joint from behind, with part of humeral head resected to show front of capsule with three glenohumeral thickenings. Long tendon of biceps is clearly shown.

capsule interferes. Forward and backward motions are checked by the acromion process. Rotation with the arm abducted is about  $90^{\circ}$ .

## CONTRAST OF SHOULDER AND HIP JOINTS

While the motion of the shoulder joint itself is not extensive, the arm enjoys an extremely wide range of motion, which leads to a brief contrast of the pectoral and pelvic girdles. We find in the hip joint the femoral head deeply socketed in the acetabulum formed by the three bones which comprise the pelvic girdle, the ilium, ischium and pubis. There is an actual negative pressure which resists an attempt to dislocate the joint and it is morphologically stable. The pelvic girdle is solidly joined to the trunk by the large stable sacroiliac joint, which in most instances has little, if any, mobility. The posterior or inferior extremity is therefore ideally designed for stability in weight-bearing. The range of motion possible in the hip joint is increased considerably by the long neck of the femur which props the inferior extremity away from the side of the body.

In contrast to this tremendous stability in the hip joint and pelvic girdle, we see the shoulder or pectoral girdle attached to the trunk mainly by muscles, its only articulation being the sternoclavicular joint. The clavicle, acting as a prop to hold the extremity away from the side of the body, increases the range of motion possible in the shoulder joint and scapula. This mechanism is quite ideal to serve the tactile and prehensile fingers with a wide range of motion. In a word, the contrast may be summed up as stability versus mobility.

## NERVE SUPPLY

The shoulder joint receives its nerve supply through the suprascapular, axillary and subscapular nerves, mainly from the fifth and sixth cervical roots.

## BURSAE

A bursa is primarily a shock absorber situated between a bony point and the skin or between a bone and a muscle or its tendon. There are a varying number of bursae adjacent to the shoulder joint.

There may be one beneath any or all of the muscles inserting into the tuberosities. Of the more constant bursae we find:

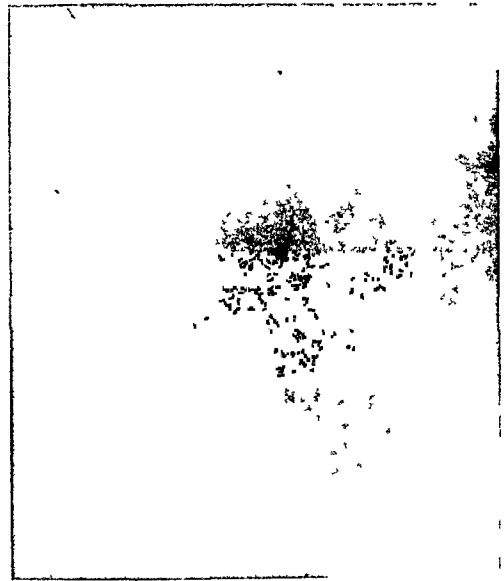


FIG. 5. M. McG. No. 89840. 1926. Dislocation of right humerus, of six weeks' duration, in woman aged seventy. Severe pain and inability to abduct arm. Head of humerus is seen below and in front of glenoid fossa.

1. The subacromial or subdeltoid is the largest, situated between the capsule and the coracoacromial ligament and acromion process, extending beneath the deltoid muscle.

2. The subcoracoid bursa lies between the coracoid process and the beginning of the coracohumeral ligament and capsule.

3. The subscapular bursa lies between the tendon of insertion of the subscapularis muscle and the capsule.

To summarize briefly the anatomical setting of the shoulder joint, we may note that it is a shallow ball and socket joint with a loose capsule, unstable in itself, depending for support on the surrounding musculature. Its apparent wide range of motion is largely due to the movement of the scapula and rest of the shoulder girdle.

## PAIN FROM EXTRA-SHOULDER LESIONS

In dealing with shoulder pain we find a very considerable number of extra-shoulder lesions which are responsible for pain in the shoulder joint. The literature abounds



with instances of these. The phrenic nerve arises from the third, fourth and fifth cervical nerves and pursues a long

ing himself, for over a year, considered in turn neuritis, myositis, bursitis, arthritis, etc., which proved to be intradural tumor

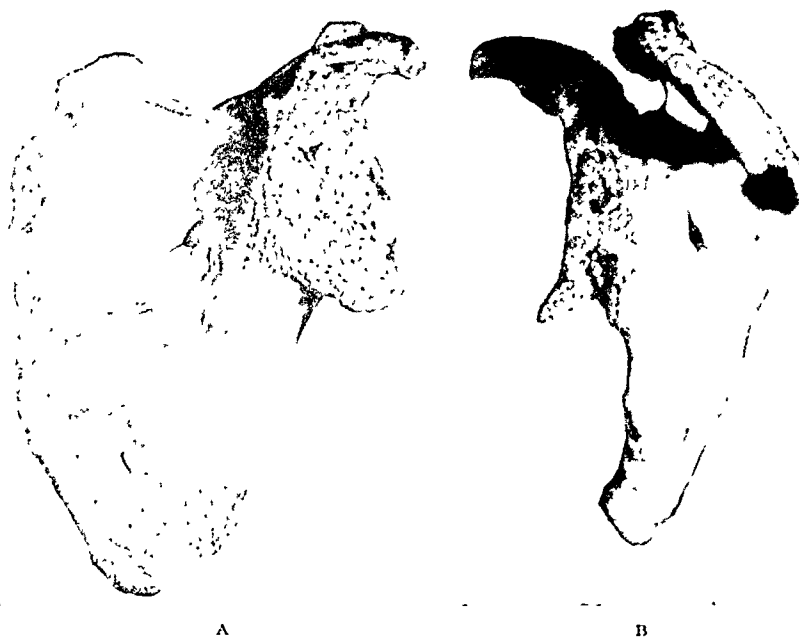


FIG. 6. Scapula in which a new shoulder joint has been made by unreduced dislocation of head of humerus.

A. New glenoid fossa beneath overhanging coracoid process and to lateral side of subscapular fossa.

B. Small atrophic original glenoid fossa below acromion process with large hypertrophied coracoid process in front of it.

Note marked evidence of hypertrophic bone change.

course through upper thoracic aperture between the pleura and pericardium to spread out over the diaphragm. When we recall that the nerve supply of the shoulder joint is from the fifth and sixth cervical nerves we see the intimate connection between these nerve paths. Cardiovascular lesions, pleural and pulmonary and mediastinal lesions and intra-abdominal lesions are frequently the cause of shoulder pain. Much has been written of this symptom in gastric and duodenal ulcers, gall bladder disease and even in ruptured ectopic pregnancy.

Conditions of a neurological nature, involving the fifth and sixth nerve roots directly, are also described. Cervical Pott's disease, arthritis of the cervical spine and cervical ribs may cause the phenomenon of shoulder pain. One of my colleagues, a neurologist, recently told me of a case of severe shoulder-joint pain which had been treated by a number of physicians, includ-

involving the fifth and sixth cervical roots. Surgical removal was followed by subsidence of symptoms.

#### PAIN FROM LESIONS WITHIN THE JOINT

Pain due to lesions within the shoulder joint or adjacent to it affords opportunity for a number of observations. I was impressed with two recent papers on this subject by King and Holmes.<sup>1</sup> In a series of 450 painful shoulders studied by them, the roentgenograms were negative in 300. Of the remaining 150, nearly two-thirds were fractures or dislocations, with infections of various types supplying the other third. I should like to emphasize one point which they made, namely, that a negative roentgenogram is of little value

<sup>1</sup> King, J. M., Jr., and Holmes, G. W. Diagnosis and treatment of 450 painful shoulders. *J. A. M. A.*, 89: 1915, 1927.

Review of 450 roentgenograms of the shoulder. *Am. J. Roentgenol., & Rad. Therap.*, 17: 214, 1927.

in attempting to rule out arthritis or bursitis because the lesion is frequently entirely in the soft parts.

and pain and disability in time disappear. Recurrent or habitual dislocations of the shoulder, where the capsule repairs imper-



FIG. 7. M. H. No. 51944. Fracture of greater tuberosity and anatomical neck of humerus in woman aged thirty-one years. Very painful swollen shoulder, almost complete range of motion after three weeks and painless in two months. Massage and active motion only treatment.

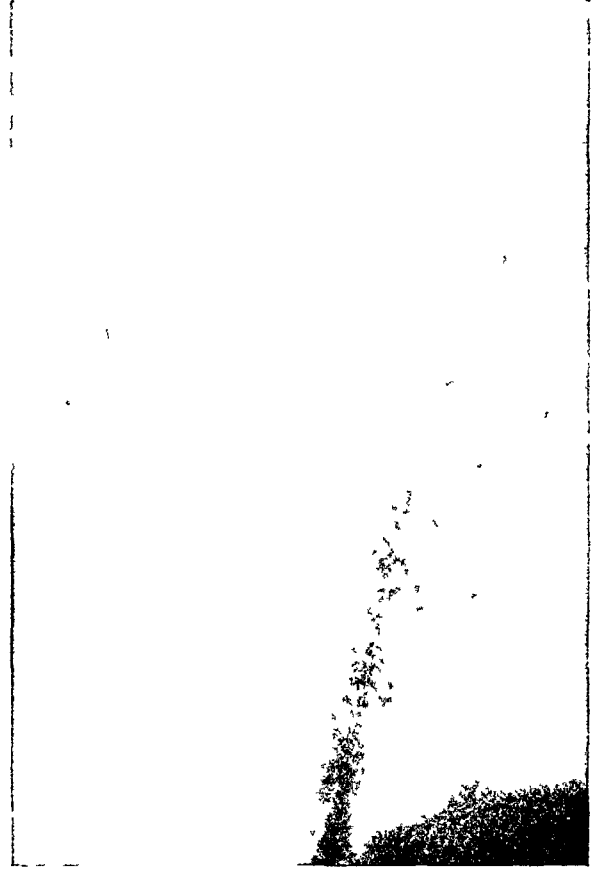


FIG. 8. P. C. No. 90517. Fracture at surgical neck and epiphyseal line of right humerus in boy of seven years.

#### TRAUMA AS A CAUSE OF PAIN

**Dislocation.** Of all large joints the shoulder is perhaps more frequently dislocated than any other. As we have noted, the shoulder relies for support on muscle tone. The accident happens so rapidly that the muscles are taken off their guard and this support is lacking. Most of these dislocations occur with the arm abducted and extended, and the tear in the capsule occurs at its lower part with the humeral head precipitated downward, inward and forward beneath the coracoid process (Fig. 5). Occasionally these are never reduced and the humeral head remains dislocated, with a stiff and painful, limited arc of motion for the extremity (Fig. 6). With a simple dislocation properly reduced, the rent in the capsule tends to repair,

fectly, form a problem of grave importance. The multiplicity of operative procedures recommended for this painful disability bears eloquent testimony to the serious nature of the task.

*Fractures* of the anatomical neck and of the greater tuberosity are of frequent occurrence and occasionally are coincident with dislocation (Figs. 7-9). It is unwise to attempt to reduce a dislocation without having a roentgenogram of the shoulder if this is possible to obtain.

While on the subject of fractures, one frequently sees a stiff and painful shoulder following prolonged immobilization or disuse of the shoulder joint following a nicely reduced Colles' fracture. Any patient beyond middle age with a fracture of the

upper extremity should exercise the shoulder joint as often as possible. If the joint has to be immobilized, full abduc-

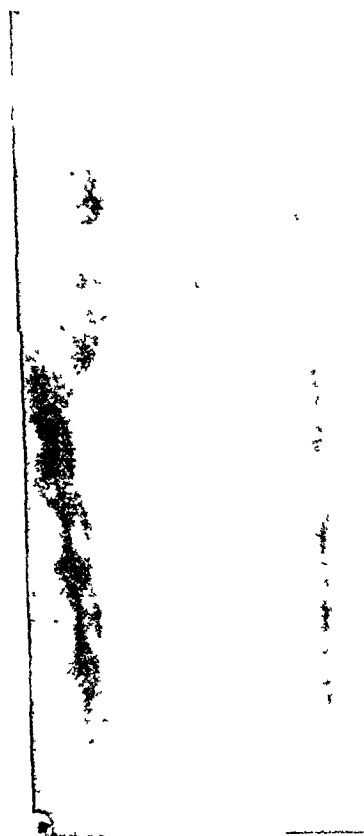


FIG. 9. A. Q. No. 88301. Boy of six years with fracture through bone cyst of upper third of shaft of humerus. Severe pain in shoulder and just below it. Solid union in five weeks. A type of fracture occasionally seen.

tion should be considered the position of choice.

*Bursitis* is middle ground between trauma and infection. Any of the adjacent bursae may become inflamed but the one most often involved is the subdeltoid or subacromial bursa.

Subdeltoid bursitis seems to fall into two types. In the first type an initial trauma: a small tear in the tendon of the supraspinatus muscle sets up an inflammation. In the other type infection *per se* seems to play the important rôle. A chilling of the shoulder such as might follow an automobile ride is followed by the characteristic symptoms, pain on abduction of the arm and tenderness over the bursa.

The tender spot disappears when the arm is abducted fully and the bursa rolls beneath the acromion process. On lowering the arm as it passes 90° there is a painful catch as the bursa rolls out again. During the acute stage these patients are most comfortable with the arm abducted. In most acutely painful shoulders, the position of abduction gives tremendous relief and abduction together with traction is frequently advisable. In the chronic stage at times calcifications form within the bursa and their operative removal has been recommended. In our hands the benefit from this procedure has been insufficient to warrant its use. These calcifications tend to disappear with the subsidence of symptoms. (See Figs. 10-13.) Our treatment is conservative, with attention paid to the various foci of infection which may be at fault.

*Neuritis.* A true neuritis affecting the shoulder joint would involve the fifth and sixth cervical nerves through the suprascapular and axillary nerves principally. This is occasionally seen following trauma such as cutting, tearing or gunshot wounds, fractures or dislocations. Pressure from a cervical rib or a crutch may be a factor to be reckoned with.

*Myositis.* A traumatic myositis such as follows a tear of the deltoid muscle is an extremely painful disability.

#### INFECTIONS

*Tuberculosis.* Of the specific chronic infections of the shoulder joint tuberculosis occasionally occurs, but the incidence is small. The weight-bearing joints are invaded by the tubercle bacillus about nine times as frequently as are the non-weight-bearing joints. The presence of tuberculosis is manifested by pain, spasm, atrophy, proceeding to actual destruction of the joint. (See Fig. 14.) The local manifestation is almost invariably evidence that the patient has tuberculosis in active or latent form elsewhere. The treatment is primarily rest, and the most effective means of securing rest in the joint is by operative fusion.

*Osteomyelitis.* Among the acute suppurative infections of this region is osteomyelitis of the upper extremity of the

lized at 70° to 80° of abduction, 45° of medial rotation and of flexion, as this is the most useful position.



FIG. 10. September 2, 1928. Patient came to hospital complaining of steady severe pain in left shoulder for two or three days and occasional pain for one month previous. X-ray shows two calcifications within subdeltoid bursa.

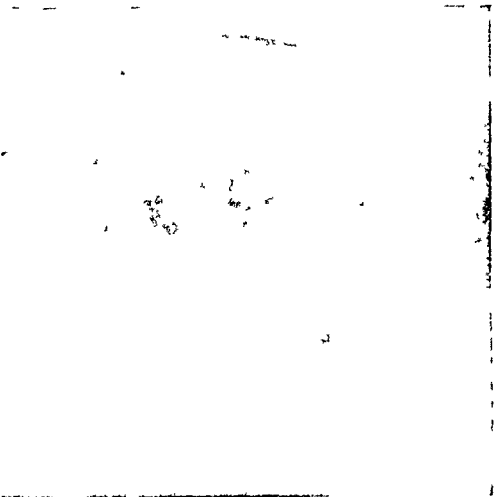


FIG. 11. September 14, 1928. Symptoms unchanged, calcifications increased in size and decreased in density.

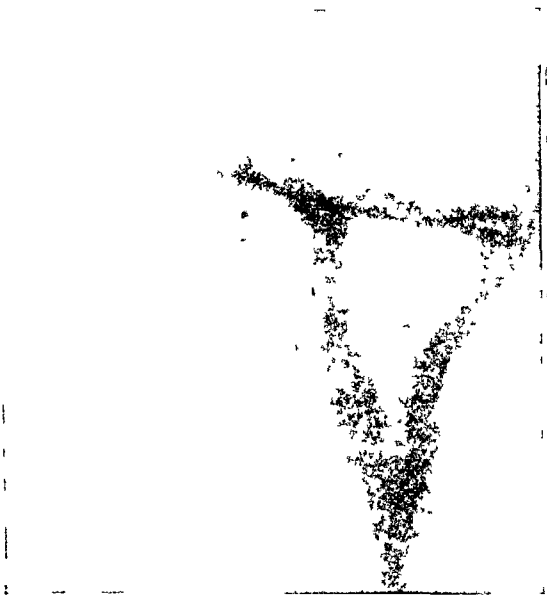


FIG. 12. October 1, 1928. Very little pain in shoulder. Large calcification has wholly disappeared and smaller only persists as minute spot.

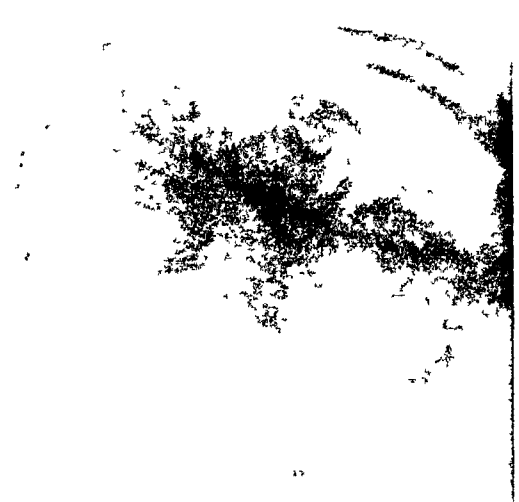


FIG. 13. October 19, 1928. Shoulder now symptomless. Large calcification gone, small one still present.

FIGS 10-13. F. F., male aged thirty-two. Series showing rapid disappearance of calcifications within subdeltoid bursa in a month and a half, while massage and rest in a sling was only therapeutic measure employed.

humerus. If this is not promptly drained it will extend into the shoulder joint and destroy it (Fig. 15). If the shoulder joint has been destroyed and bony ankylosis is anticipated the arm should be immobi-

*Arthritis.* One approaches the subject of arthritis with a feeling of deep humility when we pause to realize how little we physicians are able to help the arthritic. A large percentage of those patients who

come to us complaining of pain in the shoulder joint will be suffering from arthritis of one form or another. Our dispen-

type. Elimination of the foci of infection seems to have little or no effect. The proliferative type of arthritis, with marked



FIG. 14. R. S. No. 40603. 1927. Tuberculosis of right shoulder joint in ten-year-old boy; severe pain, atrophy and muscle spasm. Destruction of humeral head is to be noted.

saries are crowded with this army of arthritics, a few are helped here and there but the bulk of them pass from clinic to clinic seeking the relief which they seldom find.

The patient complains of a painful shoulder. On examination there is crepitation within the joint, a little spasm on motion, and some atrophy. The roentgenogram may show a few spurs, or may be quite negative. The acromioclavicular joint is often the first in the shoulder girdle to show these changes. This is the arthritis of middle age, the so-called degenerative

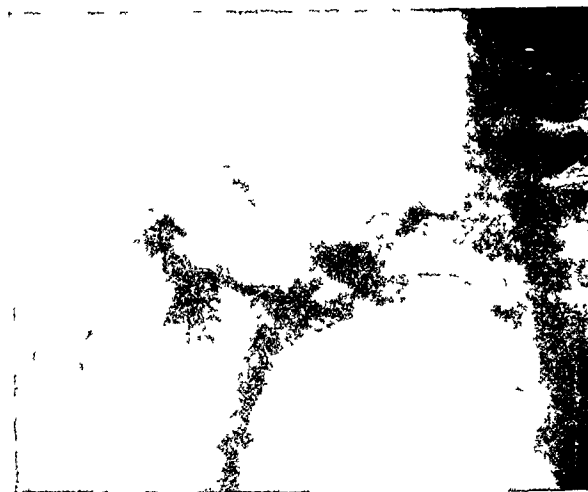


FIG. 15. J. McC. No. 93247. 1926. Result of suppurative arthritis of shoulder joint in boy of thirteen years. Disease was acute ten years previously. X-ray shows irregular reparative changes consistent with residual sepsis.

atrophy, pain and often pretty complete disability in the shoulder joint, one sees less frequently. In this type the foci of infection are of very great importance and must be carefully studied.

In closing this discussion I frankly admit that I have made no attempt to present an exhaustive treatise on shoulder-joint pain. I have omitted doubtless many important causes of this symptom and perhaps stressed some unimportant facts. As physicians we must not lose sight of the individual with the pain, in our effort to analyse this symptom. The shoulder joint is a beautiful mechanism, admirably adapted for its intended purpose, but it is not isolated and its pains and aches are not isolated problems but are intimately bound up with the welfare of the patient who consults us.

# SIMPLIFIED METHOD OF TRACTION FOR FINGER FRACTURES\*

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THERE are so many devices for finger traction that it is difficult to keep an adequate assortment available among the supplies of the surgeon. The routine use of a wire splint imbedded in a plaster-of-Paris splint in the palm simplifies the problem very much. It entails a minimum of advance preparation and almost no expense. The method is not a new one but the particular device described here offers some refinement of detail which makes for efficiency of the traction force and comfort of the patient. It is applicable to recent fractures or to those requiring open reduction.

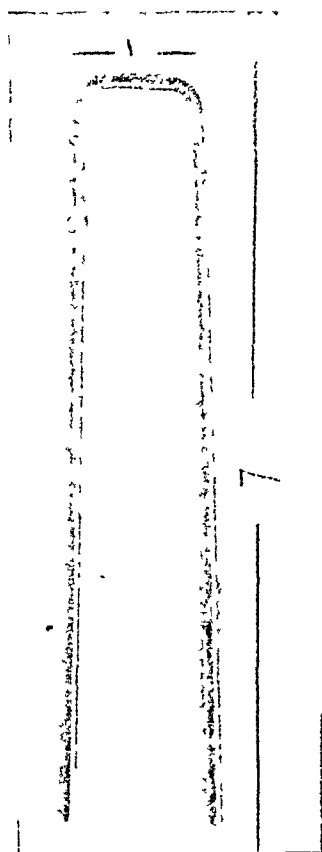


FIG. 1. Blank splint.

able among the supplies of the surgeon. The routine use of a wire splint imbedded in a plaster-of-Paris splint in the palm simplifies the problem very much. It entails a minimum of advance preparation and almost no expense. The method is not a new one but the particular device described here offers some refinement of detail which makes for efficiency of the traction force and comfort of the patient. It is applicable to recent fractures or to those requiring open reduction.

Finger traction is indicated in fractures

of the shafts of the fingers in those cases in which the palmar splint does not hold the fragments in good position. It is

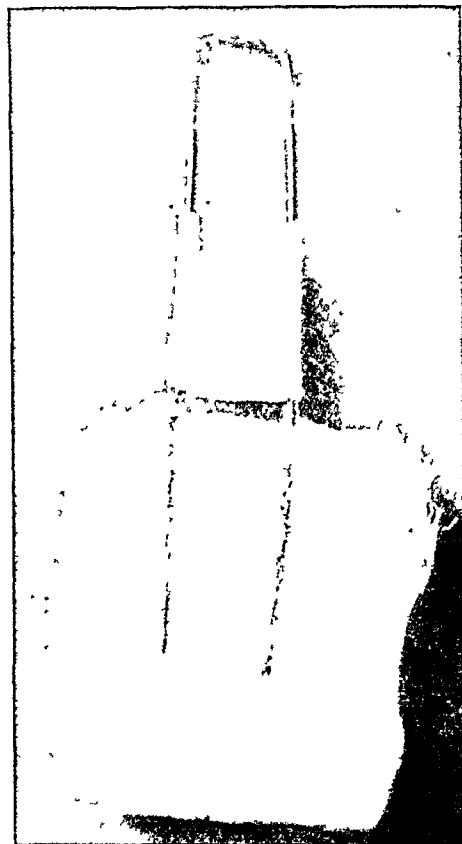


FIG. 2. Palmar aspect of splint imbedded in plaster hand piece. Positions of wires shown by black lines. Note curvature to conform to natural contour of finger.

always indicated in Bennett's fracture of the thumb. This is a fracture at the proximal end of the shaft; the distal fragment is pulled toward the trapezium, displacing the small proximal fragment anteriorly. It is imperative that traction be applied early to overcome the spasticity of the bundle of muscles surrounding the fracture.

One may obtain in the larger hardware stores copper-plated steel rods,  $\frac{1}{8}$  inch

\* Submitted for publication August 14, 1929.

in diameter in 4 foot lengths. This is known to the trade as Bessemer steel rod. If this is not available ordinary iron



FIG. 3. Wire splint as used for thumb. Position of wire in plaster hand piece shown by black lines. Note angulations of upper wire to conform to palm.

wire may be used. Copper is not so good on account of its malleability. It is well to prepare in advance a number of blanks processed as follows: Cut the rods in 15 inch lengths, place each length at its middle in the jaws of a small monkey wrench (jaws of which should be about  $\frac{3}{4}$  inch wide) and bend the two extremities sharply downward so that they lie along the handle of the wrench. Thus is formed a sharp angled U about  $\frac{7}{8}$  inch wide and about 7 inches long; this can be easily adjusted to fit any adult finger. These blanks should be kept with the fracture supplies for use as occasion arises.

The method of application of this type splint may be made very simple, but there

are several details that should be meticulously observed:

1. Apply the splint early before the initial clot commences to organize.

2. Attach the longitudinal adhesive strip (which holds a double traction cord) to the anterior and posterior surface of the thumb or finger so as not to make pressure on the edges of the nail, also prevent adhesion of the plaster to the nail by a little powder or gauze.

3. In making the plaster hand piece fold the plaster bandage over and over to make a plaster splint the width of the palm and twice as long and do not put padding on the upper surface.

4. Lay the plaster splint on the palm and wrist and place ends of splint thereon (after bending to conform to shape of palm) so that the side bars are lying along the side of the finger or thumb and extending about an inch beyond.

5. Fold over the piece from the wrist and press it tightly to the palmar section, thus embedding the ends of the wire.

6. Attach a piece of adhesive plaster between the bars of the splint to support the thumb or finger on its anterior surface.

7. Bandage hand splint snugly to hand and allow to set.

8. Make strong traction on cord and tie over end of splint and secure with small piece of adhesive.

Finish the dressing with a finger bandage which starts by turns about the wrist. The use of rubber bands is not to be recommended as the amount of force is indefinite. Also, the use of the Spanish windlass device on the cord from the finger to the end of the splint is not advised because of the possibility of producing rotation of the distal fragment. In a case of multiple fractures additional wire blanks may be incorporated in the plaster hand piece.

# CLINICAL AND PATHOLOGICAL ASPECTS OF APPENDICITIS\*

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CHICAGO

THE appendix is the organ most frequently involved of pathological conditions of the intra-abdominal organs. The substance of this paper represents the author's work at the Michael Reese Hospital Pathological Laboratory, his surgical service and association with Drs. Milton M. and Sidney A. Portis in their private practice. The operated cases were from the author's private practice and the surgical wards of the Michael Reese Hospital.

There are certain anatomical facts which I will first consider before delving into this problem. The appendix with the cecum undergoes rotation within the abdomen during embryonic development. Early in fetal life the ascending colon is found in the lower left quadrant and gradually takes an upward course toward the splenic flexure and then across the upper abdomen and down the right lateral side until the cecum reaches the right lower quadrant. Here there is a fusion of the peritoneal folds forming a more or less marked mesentery for the cecum. This rotation may assume great importance in locating the appendix when it is not in its normal position. Many surgeons have found appendices in the region of the gall bladder, and in 2 of my cases, the appendix was found under the midportion of the transverse colon in the upper abdomen. The appendix receives its blood supply from the appendicular branch of the ileocolic artery and being an end vessel has very little collateral circulation. During acute inflammations there is an acute edema and swelling of the entire organ. This produces a marked ischemia of the tissues because the inelastic serosal covering does not permit of expansion. These are several of the factors lowering the vitality

of the appendix when once inflamed, and hence increasing the rapidity of the destructive changes. The appendix has a very large amount of lymphoid structures in its submucosa, and has been frequently called the "abdominal tonsil." This latter fact may explain the frequency of acute appendicitis during any acute infectious diseases, and more especially those with involvement of the lymphatic structures elsewhere in the body.

The following are the clinical and pathological divisions of appendicitis:

1. Acute appendicitis:
  - a. Acute catarrhal
  - b. Suppurative
  - c. Gangrenous
  - d. Perforative.
2. Complications and sequelae of acute appendicitis:
  - a. Resolution
  - b. Abscess
  - c. Local or generalized peritonitis
  - d. Subphrenic abscess
  - e. Pyelothrombopheblitis
3. Subacute appendicitis
4. Chronic appendicitis.

The pathogenesis of acute appendicitis is well known, yet there are several features which I wish to emphasize. Most of the appendices become infected through the blood stream from a more or less distant focus, although many cases may have local origin from small ulcers of the appendix, especially associated with fecaliths. The earliest stage, acute catarrhal appendicitis, frequently is associated with a moderate or large amount of serous fluid in the peritoneal cavity which readily escapes on opening the abdomen. The appendix is usually injected and feels swollen and stiffened. One may sometimes find a fibrinous deposit on its surface.

\* Submitted for publication June 6, 1929.



The microscopic picture however is very definite, yet many hospital laboratories frequently overlook the early changes.

extensive infarction takes place with the ensuing gangrene or perforation.

There are several possible outcomes of



FIG. 1. Section demonstrating raising of epithelium lining appendix by serofibrinous exudate. First changes in acute catarrhal appendicitis.



FIG. 2. Second stage, illustrating breaking through of epithelial structures and permitting exudate to enter lumen of appendix.

During the earliest stages the most important changes occur in the lymph follicles which become very hyperplastic and enlarged. The lining epithelium is raised by a small amount of fluid which contains fibrin and a few leucocytes. The small vessels in the immediate region are dilated and contain an increased number of leucocytes. The exudate may then permeate the epithelial lining and enter the lumen of the appendix or may infiltrate the deeper structures of the wall. Small ulcers frequently appear in the mucosa allowing a free exit of the exudate into the lumen. A little later in the progressive cases, the suppurative element becomes very prominent and there then results a diffuse involvement of the entire thickness of the organ and if the cecal opening is closed by a fecalith or stricture, the appendix becomes very swollen and develops into an empyema of the appendix. Coincident with this swelling and edema of the organ the blood supply is interfered with, as indicated already, so that more or less

the inflammation. Resolution of the condition is the most favorable and unfortunately does not occur in the majority of cases. If it does take place very little may remain except fibrosis and sometimes partial obliteration of the lumen. However, most of the cases, when the pathology has reached the suppurative stage, rarely subside but produce either a localized abscess or peritonitis. Subphrenic abscess and pyelothrombophlebitis are quite rare but should be kept in mind as late sequelae.

Chronic appendicitis is usually not an inflammatory condition of the appendix as the name indicates, but rather the results of previous acute attacks. The pathological changes which cause the symptomatology might be better described by the surgeon than from studies on the amputated appendices. The usual operative findings are thickening of the wall, more or less kinking due to adhesions, elongation and the presence of fecaliths. Very careful studies of these cases before and after operation has conclusively shown

that the symptoms are usually due to appendiceal colic rather than appendicitis. At the operating table it is quite simple to realize the clinical possibilities, but the microscopical studies show few changes in the wall.

The clinical studies on acute appendicitis are based on 135 cases operated upon by the author from his private service and the ward service from Michael Reese Hospital. Many were neglected cases, seen late after the onset, and frequently had been subjected to drastic purging. In spite of this there were only 4 deaths from overwhelming peritoneal infections. The age factor is of great importance in considering the symptomatology. The pediatricians have separated their cases as those occurring under five and after five. I should like to add to these two divisions a third, as those occurring after fifteen. Appendicitis occurring under five may be very difficult to recognize as the picture is frequently very bizarre and almost indistinguishable from many of the acute infectious diseases. The high mortality in the very young is due partly to the late stages in which the children are seen and secondarily to the rapidity of the infectious process. The omentum is poorly developed in the young, and hence may be an additional factor in the absence of walling off of an inflamed appendix. However, there are many symptoms which are quite common to appendicitis and when these appear in children the diagnosis of acute appendicitis must be kept in mind until it is ruled out.

The onset of acute appendicitis is rarely stormy and when such does occur in an acute surgical condition in the abdomen, the diagnosis of appendiceal involvement should be made with a great deal of caution. Ordinarily the patient or the parents in the case of children will give the fact that there was first a period of several hours of abdominal discomfort. Pain is of variable intensity. In 75 per cent of the cases pain was first generalized and only after several hours did it localize to the right lower

quadrant. The maximum pain may be elsewhere in the abdomen when the appendix is situated in an abnormal position.



FIG. 3. Low power microscopic representation of a well-defined ulcer. Lymphatic follicles are hyperplastic.

In the retrocecal form the patients complained of severe backache and when the underlying ureter was involved secondarily, the symptoms simulated renal colic with red blood cells in the urine. I have seen 3 cases with frank hematuria.

Gastrointestinal distress has never been absent in any case of acute appendicitis I have seen. This may manifest itself simply by anorexia or loss of appetite or be much more severe with nausea and vomiting. The recognition of this distress is of great importance in the diagnosis and may be elicited by careful inquiry into all the subjective sensations from the last period of normalcy before the present illness. Vomiting was present in 77 per cent of all the cases and then was chiefly gastric or biliary.

The temperature was increased in the majority of cases within the first twenty-four hours. This series, however, includes 4 cases which demand special consideration as 4 children experienced a rapid rise in

temperature of 104° F. in the first eight hours and had persistently low leucocyte count. The appendices in these 4 cases were in a gangrenous condition.

The leucocyte count was increased in most of the cases with counts ranging between 15,000 and 20,000 and a definite polynucleosis. This feature is of importance but it should not be made decisive and operation should not be based solely on this finding.

The urine was usually normal except when the appendix was retrocecal, in which case red blood cells were present.

The physical findings were very important, especially that of localized tenderness in the right lower quadrant, and the degree depended somewhat on the nearness of the appendix to the anterior abdominal wall and was least marked with the retrocecal position. Exquisite rebound tenderness, which may be elicited by suddenly letting up the compressing hand, was usually diagnostic of peritoneal inflammation or free peritoneal exudate. Muscular rigidity was the most variable of all the findings and this was especially so in the very early stages. Rectal examination was important in the posterior lying appendices as it was frequently palpated and very tender.

I will not go into the differential diagnosis of acute appendicitis as it would require the consideration of a very large number of intra-abdominal and other pathological conditions for this discussion.

I will just mention treatment in passing to state that I believe in the dictum that once the diagnosis of acute appendicitis is made, operation should be performed without delay, and the appendix should be removed in all cases where it is humanly possible without subjecting the patient to too great a risk.

The symptomatology of chronic appendicitis may be very indefinite and simulate any of the usual chronic diseases of the gastrointestinal tract and biliary system. There are, however, several symptom complexes caused by chronic appendicitis

which should arouse suspicion as to appendiceal source of the complaints. Upper abdominal distress with or without pylorospasm may frequently be referred from the appendix. The underlying pathological changes in the appendix have already been discussed and as it was indicated the appendiceal colic is not dependent so much on mural changes, but is caused by adhesions and kinks about the appendix. The surgeon is frequently impressed with these findings and has noted complete relief after the removal of the appendix. I wish again to emphasize the apparent disparity between the pathological and clinical findings, and believe this may be explained on the abnormal physiology produced by the appendix's inability to expel its contents into the cecum. The finding of localized tenderness over the appendix may help in the diagnosis. The x-ray examination will usually show an elongated, kinked and irregularly filled appendix. Further, tenderness will be over the organ itself as visualized, and often one may produce referred epigastric pain by pressure over the appendix. This x-ray examination should be carried out for several days so as to determine the emptying time of the appendix, as undue delay again speaks for disease.

Chronic appendicitis is not necessarily surgical, but one should caution the patient suffering from chronic appendicitis to avoid sojourning in places where competent surgical attention is not available. The experience of my brothers in the medical treatment of this condition will be emphasized in the discussion. Just to mention, however, that correct dieting and medication to establish better gastrointestinal function with the removal of foci of infection will prevent the majority of these patients from requiring surgical attention.

#### CONCLUSIONS

The appendix, because of its richness of lymphatic tissue and being a blind pouch-like structure, is very prone to

infection. The progressive nature of the disease is dependent upon its poor collateral circulation, and the vicious tendency of the organ when once inflamed to interfere seriously with its own circulation giving rise to local tissue destruction.

The early microscopical findings of acute appendicitis are early confined to the space immediately under the lining epithelium. Here one finds at first only a fibrinous exudate which later may develop into a purulent condition. This latter may then either invade the wall or enter the lumen through small ulcers. If the appendix is not removed, perforation or gangrene with peritonitis or abscess formation frequently develops.

The recognition of acute appendicitis depends upon the sequence of symptoms of abdominal pain later localizing in the right lower quadrant, gastrointestinal distress, increased temperature, localized tenderness over McBurney's point and leucocytosis.

Chronic appendicitis as a clinical entity usually does not signify the presence of a chronic inflammatory process but symptoms due to adhesions and kinking of the appendix so as to interfere with the normal peristaltic action of the appendix. The clinical picture may simulate any of the chronic inflammatory conditions of the gastrointestinal tract or biliary tract, and the condition is diagnosed chiefly by local tenderness and x-ray showing elongation, kinking and delay of the emptying time of the appendix.

Acute appendicitis is a surgical condition and the appendix should be removed in all cases, no matter at what stage it is seen, where it is humanly possible.

Chronic appendicitis is not necessarily surgical except as a prophylactic for acute appendicitis attacks. It may be treated in the majority of cases by careful medical management directed toward establishing a normal function of the gastrointestinal tract.



# THE SURGICAL IMPORTANCE OF OCCASIONAL COMMUNICATIONS BETWEEN THE SYNOVIAL SACS OF KNEE AND PROXIMAL TIBIOFIBULAR JOINTS\*

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CUNNINGHAM'S Anatomy<sup>1</sup> states in describing the proximal tibiofibular joint: "Occasionally there is an opening in the stratum fibrosum by which communication is established between the articular cavity and the knee-joint, through the intermediation of the synovial prolongation subjacent to the tendon of the popliteus muscle (popliteal bursa)."

This communication, though acknowledged by the anatomists, is liable to be forgotten by the average general surgeon and if remembered is considered of but little clinical importance.

As long ago as 1839, before the days of antiseptic or aseptic surgery, it was recognized that exarticulation of the fibula was a dangerous procedure and was usually followed by infection of the knee joint. Gruber,<sup>2</sup> in 1845, describing communications between these two joints, states that Baron Larrey's method of amputation of the leg, with simultaneous extraction of the fibula, was condemned by surgeons of that time. The reason for such condemnation was the almost unavoidable complication of "inflammation of the knee joint." He also says that the operation of Seutin and Malgaigne for disarticulation of the fibula is open to the same criticism and that a successful operation (non-infection of the knee joint) is rare. He explains this unfortunate complication by the presence of the occasional communication (11 out of 80 dissected by him) between the proximal

tibiofibular and knee joints. In those cases in which there was no communication the close proximity of the two synovial sacs necessitates tearing of the popliteal bursa in exarticulation of the head of the fibula.

In these days of aseptic surgery this criticism is not entirely valid, but that there is still danger of suppuration of the knee joint following resection of the fibula is emphasized by the reports of the two following cases:

CASE I. E. B., white male, thirty-seven years old, admitted January 17, 1928 for treatment of painful amputation stump. Fifteen years before he was run over by a train, necessitating amputation through the upper third of the right leg. He had been using successfully an artificial leg but for the past few weeks complained of painful stump. Physical examination showed amputation of right leg 6 inches below the knee with stumps of tibia and fibula the same length, with a small ulceration over the distal extremity of the fibula. One week later the ulcer was carbolyzed, and 1 inch of the tibia and all the remainder of the fibula were removed through a curved incision over the end of the stump. Twenty-four hours later, the patient developed a hemolytic streptococcus infection of the right knee joint. At this time a mid-thigh amputation was done. Following this the patient made an uneventful recovery. Dissection of the amputated extremity showed infection of the bed of the fibula extending directly into the posterior portion of the knee through the popliteal bursa. Because of the severity of the infection it could not be determined whether the communication between the two synovial sacs was natural or artificial.

CASE II. H. K., male, aged forty-three, admitted April 9, 1928 complaining of painful

<sup>1</sup> Cunningham. A Textbook of Anatomy. Ed. 5, N. Y., Wood, 1927.

<sup>2</sup> Gruber. *Prager Vierteljahrschr. f. prakt. Heilk.*, 1: 96, 1845.

\* From the First Surgical Division of Bellevue Hospital and the Department of Anatomy, College of Physicians and Surgeons, Columbia University. Submitted for publication August 13, 1929.

amputation stump. Ten years before his left foot was frostbitten; three years before gangrene of left fourth toe developed, necessitating

The course of these two cases was almost identical. They entered the surgical wards of a general hospital complaining of painful

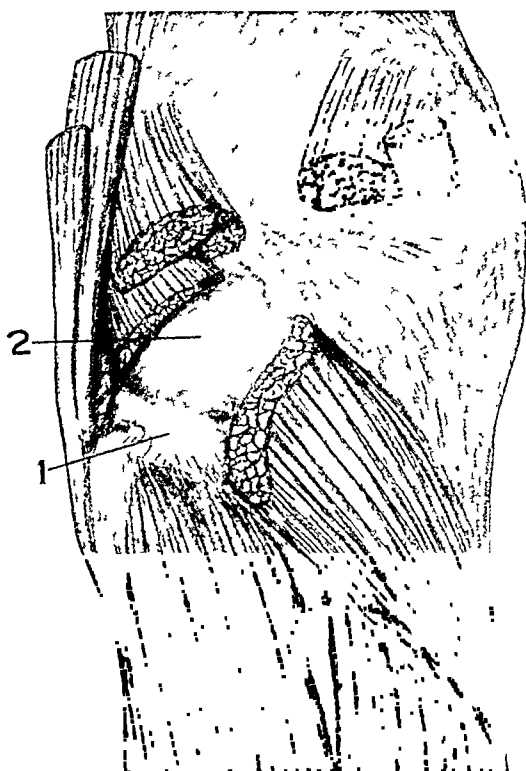


FIG. 1. Ballooning up of popliteal bursa following injection of methylene blue into proximal tibiofibular joint. This demonstrates free communication between the two cavities. 1. Proximal tibiofibular joint. 2. Popliteal bursa.

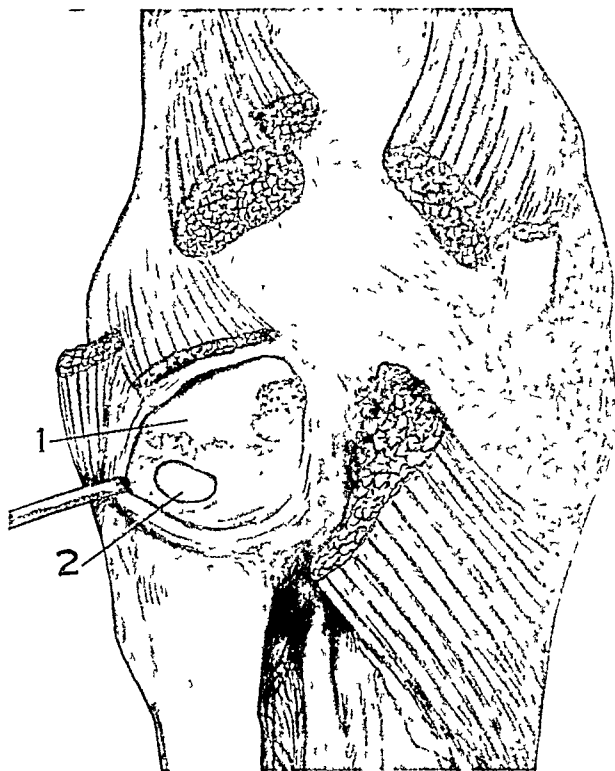


FIG. 2. Smooth-walled oval communication connecting popliteal bursa and synovial sac of tibiofibular joint. 1. Popliteal bursa opened. 2. Synovial sac of tibiofibular joint.

an amputation of the left leg below the knee. He had used an artificial limb in spite of severe pain for past two years. Physical examination showed an amputation through the upper third of the left leg, both bones of equal length and a small ulcer over the stump of the fibula. Four days later following carbolic acid of the ulcer, a lateral incision was made and the entire fibula removed, following dissection of the tibiofibular joint attachments. A small pocket of pus was discovered over the distal extremity of the tibia. This was drained. Six days after operation the patient developed a hemolytic streptococcus infection of the left knee joint. Arthrotomy was performed and Wilms treatment instituted. At this operation an oval communication between the knee joint and the old tibiofibular articulation was discovered. Patient continued to do badly and five days later a left supracondylar amputation was performed. Patient made an uneventful recovery.

amputation stumps of the upper third of the leg. Both cases had small chronic ulcers present over the extremities of their stumps. Both had their stumps revised with exarticulation of the fibula. This was done according to the recommendation of Heitz-Boyer, who advised removal of the fibula in painful amputation stumps of the leg. Infection was present in each case in the form of chronic ulceration. Acute suppurative arthritis of the knee joint followed postoperatively, in each case necessitating amputation through the thigh. In both specimens open communication was found between the knee joint and the tibiofibular joint.

The similarity of these cases and the results of surgeons before the days of aseptic surgery can hardly be overlooked. The infection travelled up the bed of the

fibula and through a natural or an artificial opening into the synovial sac of the knee.

Twelve lower extremities were dissected

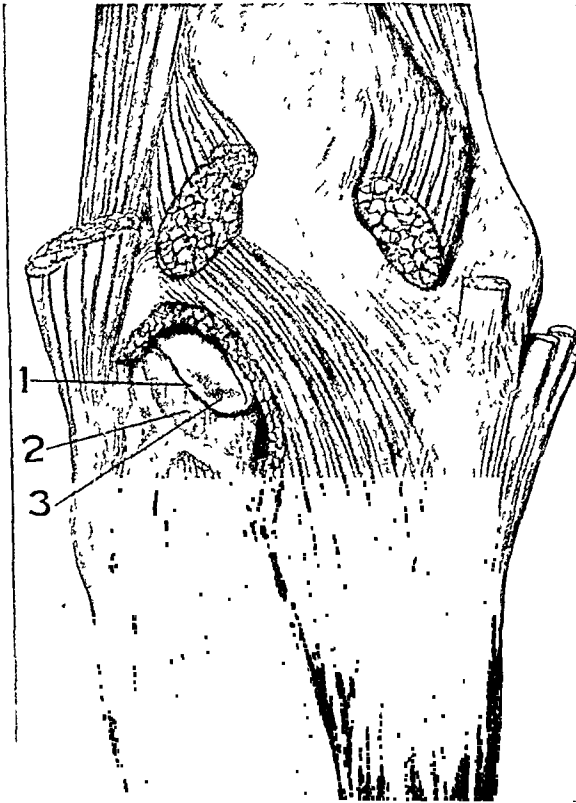


FIG. 3. Cavities separated by only two layers of synovial membrane. Injection fluid present in tibiofibular joint is seen through floor of popliteal bursa. This condition is present in the majority of cases. 1. Cut edge of popliteal bursa. 2. Proximal tibiofibular joint. 3. Injection fluid.

in the anatomy department. Methylene blue was injected into the synovial sac

of the proximal tibiofibular joint. In 4 of these 12 dissections a communication was discovered. In each of these cases the knee joint contained the dye. In the 8 which showed no such communication the striking fact determined was the close proximity of the two synovial sacs. In all, the prolongation of the popliteal bursa overlay the roof of the tibiofibular synovial sac, the two cavities separated only by thin layers of synovial membrane. In such a case removal of the head of the fibula would inevitably involve opening the knee joint through the popliteal bursa.

The anatomy of this region is well described by Henle.<sup>1</sup> He reports that when such communications exist the articular cartilage of the knee joint becomes continuous with the articular surface of the tibiofibular joint. This observation was made in each of the 4 dissections made by the author in which communication existed.

#### CONCLUSIONS

1. The synovial sacs of the knee and the proximal tibiofibular joints communicate in about 15 per cent of cases.
2. Where no such communication exists the close proximity of the two synovia necessitates injury to the popliteal bursa in exarticulation of the fibula.
3. Acutesuppurative arthritis of the knee joint may readily follow removal of the head of the fibula in the presence of infection.

<sup>1</sup> Henle. *Anatomie des Menschen*, Bd. 1, Abt. 2, 145.



# OPERATIVE INJURY OF THE URETER\*

## REPORT OF 5 CASES WITH A REVIEW OF THE LITERATURE

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THE following 5 cases of operative injury of the ureter have come under the observation of the writer during a recent two-year period.

CASE I. Mrs. M. W., aged thirty-eight years, housewife. On November 26, 1926, during a hysterectomy and right salpingo-oophorectomy operation, the lower ureter was accidentally clamped and cut across during the operative procedure.

Immediately following injury the gynecological surgeon performed an end-in-end anastomosis of the ureter, invaginating the lower end of the upper segment into the lumen of the lower segment, and reinforcing the same with fine plain catgut sutures. Three days following this operation there was a rise in temperature, pain in the right kidney region with pyuria with slight hematuria, and the abdominal wound broke down, discharging a large quantity of urine.

Cystoscopic examination on December 10, two weeks after operation, showed some degree of cystitis. Left ureter catheterized normally with return flow of clear urine. The ureteral catheter, however, on the right side was temporarily obstructed at a point about 10 cm. from the bladder. On passing farther up the ureter a catheter entered freely with a return flow of about 100 c.c. of urine with the terminal portion cloudy, indicating a definite hydronephrosis. Function of the left kidney was normal, while the phenolsulphonaphthalein test showed a marked delay in function on the injured side. The catheter in the right pelvis was fastened in position for three days with frequent irrigation to relieve the hydronephrotic condition.

A second cystoscopic examination was performed on December 21, eleven days after the first cystoscopy. This also showed a moderate degree of hydronephrosis with temporary obstruction in the right ureter at the same point, 10 cm. above the bladder. There were signs of slight infection at this time but marked improvement. Very soon after the first cystoscopy was performed, the drainage of urine

from the wound was materially lessened. On January 7, 1927, cystoscopy showed a normal bladder, the lumen of the right ureter entirely free with no evidence of hydronephrosis or infection with normal function. The wound healed rapidly from this time on until she was discharged on January 20, 1927 with wound entirely healed.

CASE II. Mrs. S. O'B. was operated upon January 3, 1927 by another gynecological surgeon and, during the removal of a very large ovarian cyst, the left ureter was accidentally severed at a point about 12 cm. from the bladder. In this case the operating surgeon also performed an end-in-end anastomosis, invaginating the stump of the lower end into the lumen of the upper segment and reinforcing with fine catgut sutures. In this instance, also, the wound broke down after three or four days with discharge of urine, and the patient was cystoscoped one week after operation. Temporary obstruction was encountered with a small soft No. 4 olive-tipped bougie at a point 12 cm. from the bladder. This was finally passed and a very moderate hydronephrotic pelvis found, with slight infection. In this instance it was deemed advisable not to leave the catheter in situ in view of conditions of the case. A second cystoscopic examination was done one week later, and a No. 5 and 6 F. catheter were each passed to the pelvis, and about 12 c.c. of hazy urine obtained. Gentle lavage was done with silver nitrate solution 0.5 per cent. The urinary drainage from the abdominal wound gradually subsided and she left the hospital about three and one-half weeks following the original operation, completely healed. Eighteen months after leaving the hospital the patient returned to my office for cystoscopic examination, at my request. She had been entirely well since leaving the hospital, and cystoscopic investigation showed a normal condition of bladder, ureter and pelvis and kidney.

CASE III. Mrs. O. C. on March 3, 1926 has a complete hysterectomy performed by another gynecological surgeon. The operation

\* Read before the Kings County Medical Society, May 22, 1929.



was entirely smooth and the operator did not know that the ureter had been injured at the time. Several days later, however, there was

CASE IV. Mrs. H. K., aged forty-eight years, married, was admitted to the Long Island College Hospital on May 3, 1927 and



FIG. 1. Pyelogram of Case 1 shows hydronephrosis from ureteral obstruction. Note iodide solution diffused in tissues about lower ureter at site of ureteral injury and fistula. Recovery was later complete.



FIG. 2. Ureterogram of Case v with complete block just below renal pelvis at site of ureteral anastomosis.

considerable drainage of urine from the vagina with pain and rise of temperature. Patient was allowed to go for three weeks in hope that this fistula would heal. Urinary leakage continued and cystoscopic examination on March 26, 1926 showed an obstruction to catheter in the left lower ureter only 3 cm. from the ureteral meatus. This could not be overcome by any catheter or bougie. Subsequently a second laparotomy was performed and the left lower ureter was isolated, divided at obstructed point and implanted into the bladder. This healed well and there was no more recurrence of urinary drainage per vaginam. She left the hospital in May 1926 entirely healed but refused all requests for cystoscopic study. We have been unable to ascertain the whereabouts of this patient since that time.

died of uremia on May 11, 1927. She had been operated upon nine years before, a hysterectomy having been done. Following this operation, urine drained from the vagina for several months but finally ceased. For about a year before admission to the Long Island College Hospital she was under treatment for marked hypertension, and suffered occipital headaches, buzzing in the ears, and paresthesias in the hands and feet. Further examination revealed a high nitrogen retention in the blood, which gradually increased with development of anuria.

Cystoscopic examination revealed an impassable stricture 5 cm. above the left ureteral meatus. A large hydronephrotic mass was palpated in the left loin and upper abdomen. The extreme condition of the patient did not permit of operative procedure. The nitrogen retention continued to increase. The patient lapsed into deep coma and died eight days after admission.

Necropsy revealed an arterio-sclerotic, contracted kidney on the right side, with a very large thin-walled hydronephrotic kidney on

somewhat of the intrarenal type so that free exposure was necessary to facilitate stone removal. Following the operation, the stump



FIG. 3. Fistula in renal wound injected with lipiodol, Case v. Filled pelvis indicates distortion and rotation. Nephrectomy required.

the left side, dilated ureter with complete occlusion of its lumen near the bladder and surrounded with scar tissue. In this instance we have a striking example of the late results of operative injury of the ureter. Unfortunately, the patient had a complicating arterio-sclerotic kidney on the opposite side which did not permit nephrectomy. One is inclined to believe that early implantation of the lower ureter into the bladder following the hysterectomy operation, when the vaginal fistula developed, would have prevented the ureteral stricture and resultant destructive hydronephrosis.

**CASE V.** Mr. R. C., aged forty-four years, married, had a pyelotomy performed by the writer on August 27, 1928, for a large stone in pelvis (about 2.5 by 3 cm.). During this procedure, while removing a large amount of dense, adherent, fibrofatty exudate from the posterior renal pelvis, the ureter was completely divided at its junction with the pelvis. The pelvis was

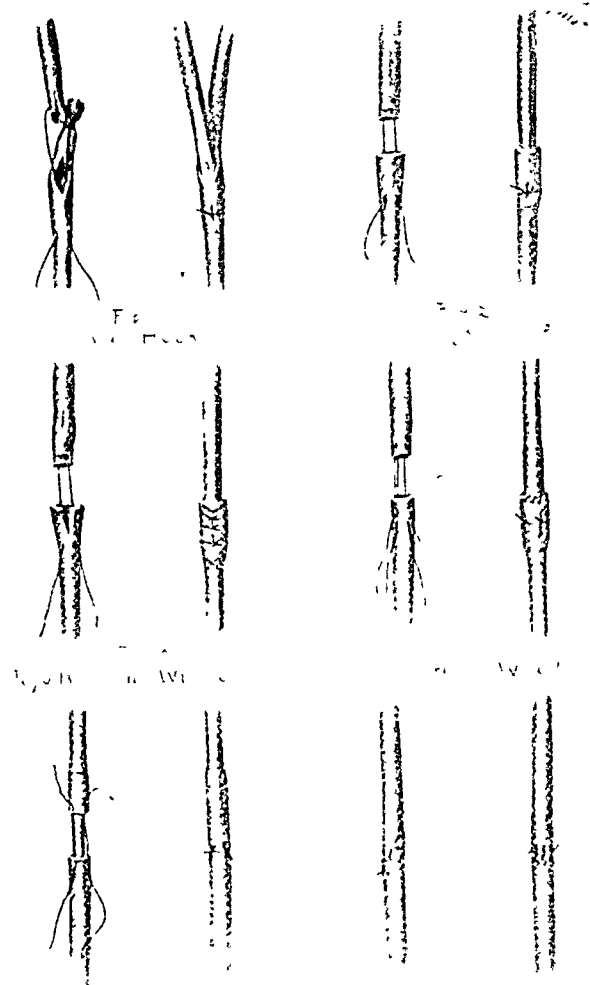


FIG. 4. Few of more commonly employed methods of ureteral anastomosis. (After Sharpe.)

of the ureter was very carefully sutured to the pelvis, telescoping the divided ends, placing the ureter within the cavity of the pelvis, and suturing from without with No. 00 plain catgut. A flap of fat was further sutured around this area for protection. There was temporary drainage from this ureter into the bladder as was proved by cystoscopy and the ureter catheter. Urine, however, continued to drain in considerable quantity from the wound in the flank, and attempts to drain the pelvis with an in-dwelling catheter failed.

Cystoscopic examination on September 10 showed that there was complete obstruction in the ureter at a point 22 cm. from the bladder with no return of urine from the catheter.

Ureterogram showed complete occlusion of

the ureter at this point so that no iodide solution entered either the pelvis or the urinary fistula in the flank. Injection of the wound

and pelvis resulted successfully. In one of these Dr. Hamilton Bailey encountered a complete divulsion of the pelvis from the kidney.

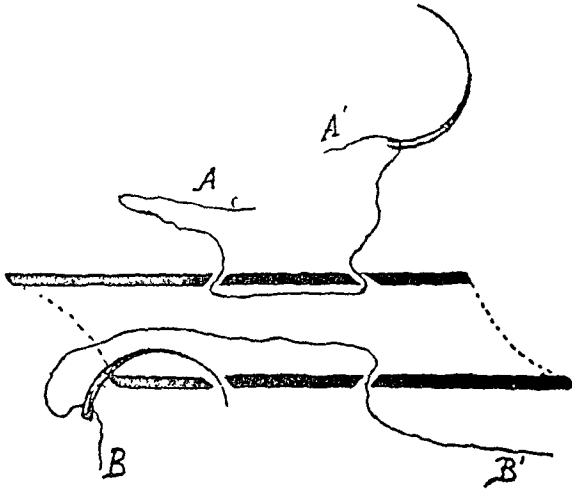


FIG. 5. Diagram of magnesium tube of Prof. Taddei with No. 0 catgut sutures in place, ready to be inserted into ureteral lumen.

with lipiodol solution showed an odd type of pyelogram with rotation of pelvis and considerable solution in the surrounding spaces. Left nephrectomy was, therefore, performed on October 4 with an uneventful recovery.

The kidney was found to be surrounded with extensive, dense adhesions and scar tissue, which could not be liberated from kidney excepting by the use of bold, free dissection with curved scissors. The kidney in the gross seemed to be in fairly good condition. The ureter near the pelvis was found to be converted into a firm cord for a distance of about 5 cm. Section of the kidney removed showed multiple abscesses with infiltration, fibrosis, and with atrophy of the parenchymatous elements.

C. H. Peck has shown the importance of "splinting the ureter" by a catheter passed down the ureter to prevent post-operative obstruction after plastic operations upon the renal pelvis, and even after kidney suspension operations. This catheter is brought out through a stab wound in the kidney and out of the wound in the flank, remaining in position for several days. Two similar cases are reported in the *Journal of Urology* of the present year (1929) by two different urologists, in which anastomosis of the ureter

#### COMMENTS

The relative frequency of these cases, together with the interesting problems involved, has prompted me to make a study of the literature upon this important subject. A thorough study proves that operative injury of the ureter is by no means a rare condition. In fact, it is probable that a relatively large number of cases, occurring in the hands of individual operators, never find their way into print. This is borne out by statements of eminent authorities such as Baldy, Culbertson and others. In 1925 Bland collected 316 cases from the literature and also gathered 125 additional cases from surgeons actively engaged in abdominopelvic work, making a total of 441 cases. The 125 cases were reported from forty-two surgeons, making an average of 3 each. Bland, himself, stated that he injured the ureter six times over a period of fifteen years. Of the total series of cases 360 were unilateral and 81 bilateral. It is worthy of note that frequent operative deaths attributed to "suppression of urine," particularly in radical pelvic operations of former years were, no doubt, the result of ureteral occlusion. Fortunately, many of the radical operations for carcinoma of the uterus, where accident is most likely, are being abandoned. Injury occurs most frequently during gynecological procedures, especially hysterectomy, less often during urological or other abdominal procedures. Ligation is said to be the first in point of frequency, clamping second, and incision by scissors or knife third. The clamp is usually followed by sloughing. Ligation, if unilateral, may go unrecognized. In this connection it is interesting to note that Barney, in ligating one ureter in 37 animals, found that anuria with renorenal reflex did not occur once. The ureter has also been injured during simple vaginal

drainage, and in difficult forceps delivery cases. Injury is most likely to occur during ligation of uterine and ovarian vessels.

obviously cannot be foretold. In Case iv of this series practically complete obliteration of renal tissue with extreme hydrone-

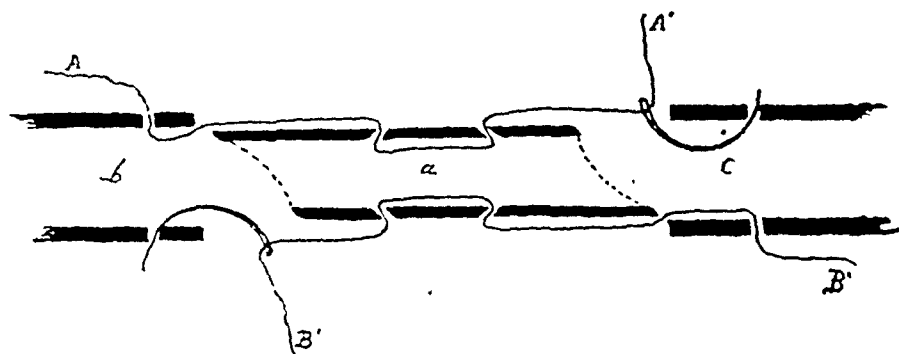


FIG. 6. Taddei's magnesium tube in position for anastomosis, sutures passed through ureteral walls, larger bite of ureteral stump taken in vesical end.

The writer cannot stress too strongly the importance of early cystoscopy in all cases where ligation or other injury is suspected. In some instances it may not be detected until an abdominal or vaginal fistula develops. In all of these cases immediate cystoscopy may be the means of saving a kidney which is otherwise doomed

phrosis resulted nine years after operative injury. Brown mentions one instance of a thin kidney cortex with secretory activity ten years after complete obstruction. He also reports an instance of removal of suture which accidentally ligated the ureter with recovery of the patient. In another case, ureterovesical implantation

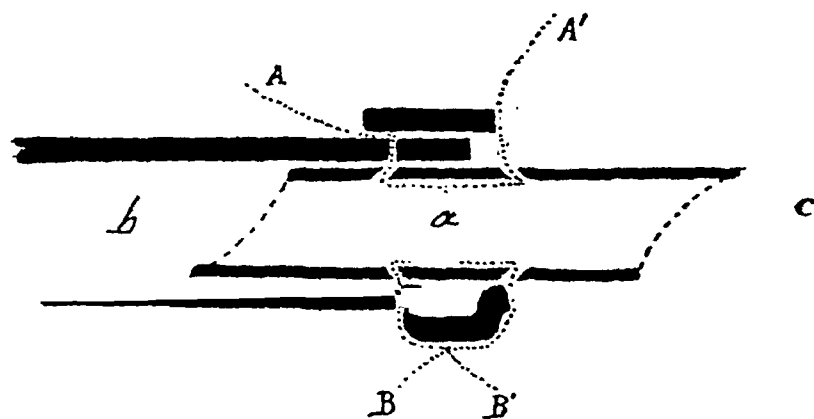


FIG. 7. Taddei's tube in position with sutures A-A' and B-B' drawn taut, B-B' tied and A-A' about to be tied. Note renal stump invaginated into vesical stump with magnesium tube acting as splint.

to destruction. Caulk and Fisher report a case of double nephrostomy done on the eighth day after injury with recovery of the patient. In this instance complete repair of the wounds was accomplished on the fifty-eighth day. Furniss reports a case in which both ureters sloughed after clamping for the short period of seven to eight minutes. The slough manifested itself on the eighth and twentieth days on each side.

The end-results of operative injury

resulted successfully after severance of the ureter.

In injuries at the lower end of the ureter, ureterovesical anastomosis is, probably, the one of choice. The report of A. Petersen based upon 21 dog experiments and 21 human cases concludes that a "normal or almost normal kidney and ureter should result following implantation of the ureter into the bladder." At higher levels the uretero-ureteral anastomosis should be done by one of the various methods, pro-

vided the severed ends can be brought into apposition with sufficient relaxation of the rest of the duct. End-to-end anastomosis

means of saving the kidney, even though ureterovesical implantation might have been required.

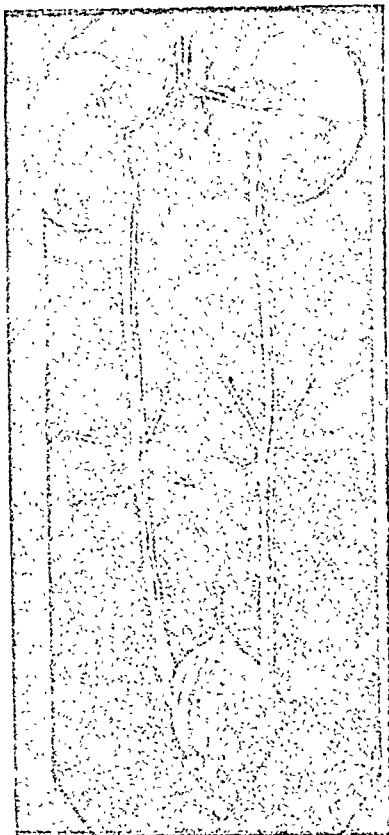


FIG. 8. Result of Taddei's magnesium tube method of anastomosis. Note normal appearance of ureters, pelvis and kidney. Autopsied dog showed no pathological results.



FIG. 9. Photograph of kidneys and ureters of dog killed nine months after operation. A. Site of suture of right ureter. This shows excellent result of end-to-end suture after employing side slit drainage of urine above area of anastomosis. (Courtesy Drs. Bump and Crowe.)

with invagination, after the method of Poggi or Van Hook, is the most popular. H. H. Young recommends end-to-end suture over an indwelling ureteric catheter.

Considerable success has been met with clinically in uretero-ureteral anastomosis. The reason for this is the remarkable power of repair of the ureter. This fact is, probably, not fully appreciated. Ultimate success depends almost wholly upon the maintenance of canalization of the lumen. Temporary hydronephrosis and infection resulted in 2 of my cases due to temporary obstruction which was readily overcome by follow-up cystoscopic procedure. In Case iv we feel rather definitely that cystoscopy done when the ureterovaginal fistula developed would have been the

The basis of results in ureteral injury and repair are to be found in numerous dog experiments. Joannides and Holmes proved, in 17 experiments, that tubulization of the ureter would take place with healing around an in-dwelling catheter even when a gap of 1 or 2 cm. was intentionally left between the severed ends. In only 2 of these did hydronephrosis develop. Where a gap is left, however, stenosis is more likely to take place. These writers, in 1925, state: "uretero-ureteral anastomosis should be the method of choice if one could have a rigid mechanism for keeping the lumen patent until complete healing takes place." These authors, are, no doubt, unmindful of the fact that just such a piece of most excellent and successful work has

been done. I have been unable to find any reference in the English literature to it except the mention of the method in the book of Thomson-Walker. I refer to the 6 dog experiments of Professor Domenico Taddei of Florence, Italy (1904) whose work has been translated for me. He uses a perforated, soluble tube of magnesium in the lumen of the severed ureter. Its length is 1 cm., calibre 1 to 3 mm., with thin walls and with rounded, tapered, oblique, parallel ends. His studies are complete and reveal 100 per cent success, even histologically, in the ureter and kidney of all cases. In none was any trace of the magnesium found after twenty days. I have communicated with the author with the hope of further knowledge and studies in this important contribution to urological surgery.

One of the earliest operations of ureteral anastomosis was that of Simon in 1851 at St. Thomas' Hospital, London. A large percentage of the earlier cases on record were rectal implantation of the ureter for exstrophy of the bladder. To our own Coffey belongs the credit for perfecting the technic of rectal implantation.

Alksne, 1908, collected all the reports of uretero-ureteral anastomosis and found 43 complete recoveries in 60 cases, 9 recoveries after temporary fistula and 8 deaths (mortality 11.6 per cent). In 1887 Poggi reported 2 successful cases of ureteral invagination in dogs, which, when autopsied, showed no stricture. His method, since that time, according to Alksne, showed the best results; 12 per cent of fistulae occurred in 28 cases, while the circular method showed 24 per cent of fistulae.

Van Hook's experiments in dogs, reported in 1893, are also an interesting and valuable contribution. Sampson has shown further that the ureter will stand considerable manipulation, even to stripping. Margavucci, also, isolated the entire ureter in 10 dogs without resulting necrosis. He believes that the blood supply from the renal artery is almost sufficient. He has taught us the valuable point in all ureteral work, that special care must

be exercised in all cases to conserve the periureteral arterial plexus.

Arthur H. Curtis has recently shown a



FIG. 10. Pyeloureterogram of patient five months after anastomosis of severed ureter. P, Normal kidney pelvis. A, Site of ureteral anastomosis. Clinical case of Dr. Arthur H. Curtis who successfully employed method of Bump and Crowe with side slit drainage of urine above line of suture.

very successful result of uretero-ureteral anastomosis in the human after the method of Bump and Crowe, which method at this writing has not been published. As suggested by L. L. McArthur, the urine is temporarily drained through the flank by a catheter passed through a slit in the ureter above the site of anastomosis.

The methods of anastomosis, as given by Thomson-Walker, are listed as follows:

- (1) End-to-end
  - (a) Horizontal
  - (b) Oblique
- (2) End-to-end (Poggi)
- (3) Special soluble magnesium tube (Taddei)
- (4) Invagination method of Van Hook

(5) Lateral anastomosis with ends closed. The author states it is well to cover the area of repair with fat tissue to aid closure.

it, end-to-end anastomosis with invagination, or ureterovesical implantation, should be done according to the level of the injury.

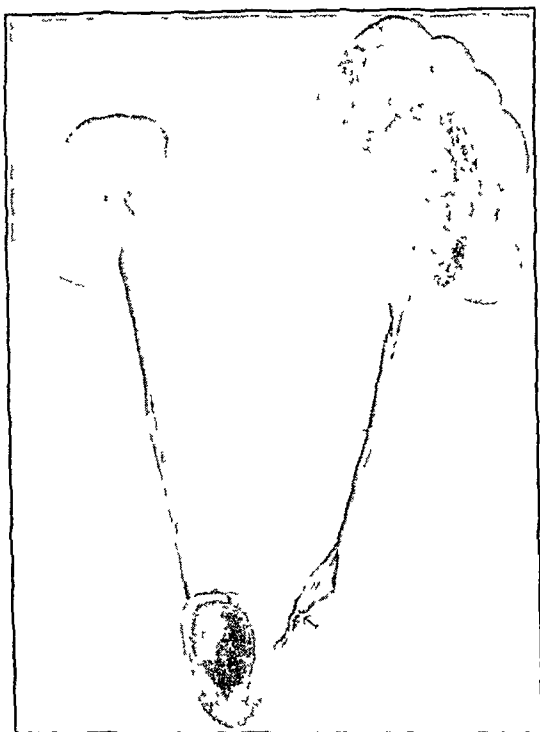


FIG. 11. Case iv. Autopsy specimen. Arrow indicates point of complete strictural obstruction with dilated ureter above with large hydronephrotic pelvis and kidney. Note lobulated appearance of thinned sac-like renal cortex. Opposite kidney shows granular contracted appearance of arteriosclerotic kidney. Result of surgical injury of ureter nine years before.



FIG. 12. Case iv. Longitudinal section of lower ureter. Arrow indicates strictured ureter with dilation above. Note also darker hemorrhagic appearance of mucosa below area of stricture resulting from instrumental attempts during previous cystoscopy to pass point of obstruction.

Bickham discusses sixteen different operations of ureteral anastomosis. These fall into two general groups:

- (1) End-to-end
- (2) End-in-end.

A case of lateral anastomosis of a double ureter was successfully and ingeniously employed by Foley for the relief of obstruction in one of the branches of a bifurcated ureter. I have taken the liberty of reproducing diagrams of the various methods employed.

During surgical procedures, special care should be exercised in isolating the ureter, particularly in difficult pelvic work. In some instances, the in-dwelling ureter catheter may be very helpful. When accident occurs, and the operator knows

Repair is best done at the time of accident, provided the surgical condition of the patient warrants, without jeopardizing the patient. If not, the ureter must be brought out upon the abdominal wall temporarily, or preferably through a stab wound in the flank, until further repair work can be done. Nephrectomy is, usually, the last resort in all instances, although in certain cases, the kidney must be sacrificed. Where ureters have been ligated, a number have resulted successfully following removal of the ligatures after a short period. In point of identifying the ureter as a definite precaution, Robinson emphasizes the following points:

- (1) Kelly's vermicular contraction test, i.e. stroking the ureter for peristalsis

- (2) Absence of pulsation
- (3) Consistency and thickness of walls
- (4) Attachment to posterior leaf of peritoneum.

## CONCLUSIONS

1. Surgical injury of the ureter is far more frequent than commonly supposed.
2. Complete repair should be done at the time of accident, provided the condition of the patient makes it possible.
3. Uretero-ureteral anastomosis with invagination is the method which has been most successful (Poggi and Van Hook methods).
4. The soluble magnesium tube of Taddei appears to be a valuable contribution for successfully canalizing the ureter at

site of injury. This method has evidently not received the attention it deserves.

5. Certain definite principles of identification and isolation of the ureter, if carefully followed, should aid in reducing the incidence of ureteral injury.

6. Early cystoscopy should be done in all cases where ureteral injury is known or suspected. This may be the means of saving a kidney, or even the life of the patient.

7. Cystoscopic exploration of the ureter should be done at intervals, for a time at least, following anastomosis. This depends upon the tendency of the operative area to stenosis.

8. It is worthy of note that the literature upon the surgery of the ureter has increased considerably in the past five or six years.

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## CASE REPORTS

### TUBERCULOSIS OF THE VAGINAL TRACT\*

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THE incidence of primary tuberculosis of the vulva and vagina is rare and yet its importance is none the less significant. Few cases in living subjects have been reported to date. Freidlander reported a case in 1873; six cases have been reported since then. This condition has been much more frequently found at necropsy than in clinical practice and when found is almost always associated with generalized tuberculosis.

The literature dealing with this condition is exceedingly rare, of which Wharton has given us one of the most recent and modern descriptions. A summary of all cases reported would give a series as Wharton says of about 75 cases nearly all of which were discovered at autopsy. Clinicians have failed to discover tuberculosis of the vulva and vagina in the living subject probably because most of the patients had generalized tuberculosis and the vaginal tract was overlooked.

#### PATHOLOGY

The pathology of this disease is shown by the appearance of one or more chronically inflamed indurated nodules located in the vulva or vaginal wall. They may be separate or conglomerate. Two forms are recognized chronic indolent. The nodule or nodules may be ulcerated and discharging a slight amount of serosanguinous pus. The drainage is usually never excessive. The edges of the ulcers are usually undermined, indurated and irregular with nodular granulating bases which bleed only slightly when manipulated. Frequently the ulcers may have healed, leaving a cicatrix with

a surrounding pigmented area, especially in the involved skin areas, or one edge of the ulcer may have healed and the other edge may show a progressive breaking-down of tissue. Some of the tubercles may show caseation while in other cases caseation is difficult to demonstrate. There nearly always are enlarged inguinal glands in one or both groins. Cases of long duration may show extension of the tubercles into the adjoining tissues involving especially the perineum. Microscopical examination of a biopsy specimen may show little or no direct evidence of tuberculosis only that of a chronic inflammatory area. Several biopsies may be necessary to establish a definite diagnosis of tuberculosis. The blood may present a normal picture, the only exception being that of a low polymorphonuclear giving way to a high mononuclear count. The urine shows no involvement. The freedom of the vaginal tract and vulva from tuberculous infection according to Norris is due to the resistance of the epithelium covering especially the horny layer.

#### SYMPTOMS

The symptoms may either be local or general depending upon the degree of involvement. The local symptoms are characterized by either no pain at all or a dull ache or slight pain in the region of the vulva or vagina. There may be bleeding and edema of the vulva especially in children. The pain is more severe in the pelvic and lumbar region when there is a pelvic involvement. These patients usually have poor appetites. Intermittent

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constipation and diarrhea may be complained of where there is an involvement of the intestinal tract. Frequent urination may exist with hematuria where there is an involvement of the urinary tract. Pulmonary involvement is attended with considerable coughing, and occasionally expectoration of bloody sputum, loss of appetite and night sweats. In fact weakness, loss of appetite, and night sweats may be a common complaint among most cases with extensive involvement.

#### DIAGNOSIS

The patient may be a healthy robust-looking person if the disease has not been one of long standing or she may present an emaciated, weak and anemic appearance. Most tuberculous cases of the vulva and vagina show a pulmonary involvement which first attracts the attention of the diagnostician. Primary cases on the other hand often present greater difficulties in diagnosis because there are no other noticeable foci. Examination for tuberculosis of the vaginal tract is seldom made unless there is a considerable area of infection, ulcerative in character, sufficient to give rise to an unusual vaginal discharge. This condition is quite apt to be overlooked especially in adult women because of the frequency of a leucorrhea which is often given no significance among them. Examination will reveal usually one of two forms, an ulcerative or a hypertrophic type involving the vulva and occasionally the vagina. The ulcerative form is characterized by a solitary or multiple ulcerated nodule located on any part of the vulva and frequently the vaginal walls. There may be a fistula leading from the ulcerated area to a tuberculous focus in the lower intestinal tract or the ulcer may have healed in one area leaving scar tissue behind while it has spread to a new area. The ulcer may be excavated, have sharp undermined margins, or it may be nodular or covered with exuberant granulations which bleed only slightly when manipulated.

The lesion presenting must be differentiated from gonorrhea, senile vaginitis, and an ulcerative condition resulting from trauma, prolapsus, syphilis, cancer, actinomycosis, or esthiomenus. Many cases can be differentiated only by blood tests and histological examinations of biopsies. The histological picture of tuberculous ulcers usually shows areas made up of dilated thrombosed blood vessels, round-cell infiltration and extensive proliferation of epithelioid and connective-tissue cells. These areas or tubercles may show degenerative processes resulting in caseation and giant cells. Giant cells, although usually present, are not however necessary adjuncts to a tuberculous nodule. Special staining may fail to demonstrate *Bacillus tuberculosis* in the nodule.

The hypertrophic form is characterized by an extensive swelling of the labia major or by one or more large rounded indurated nodular areas of the vagina. The areas are covered by thickened epithelium. These cases are much more difficult to diagnose than the ulcerous type and are very frequently mistaken for carcinomata, sarcomata, condylomata acuminata, elephantiasis or esthiomenus. A histological examination is often the only exact method of differentiation and even by this method they frequently offer diagnostic difficulties, for tubercles with giant cells and *B. tuberculosis* are often very difficult to demonstrate. No case should be classified as tuberculous without the characteristic tubercle showing epithelioid cells, dilated blood vessels, giant cells, round-cell infiltration, plasma cells, and if possible *B. tuberculosis*.

The disease is differentiated from a Neisserian infection by failure to find the gonococcus in the stained smears. Gonorrheal vaginitis in children is never ulcerative, tuberculous vaginitis usually is, while chronic non-specific vaginitis shows a tendency for the vaginal walls to adhere to each other resulting in atresia which does not occur in vaginal tuberculosis. Ulcerative conditions of the vulva

and vagina due to trauma or prolapse are always accompanied by a different history than those of other infections and healing readily takes place after the proper correction is made. Lues is often very difficult to differentiate from tuberculosis in these cases. It demands a carefully prepared history and examination including laboratory and serological tests.

The most important problem in diagnosis is the ruling out of malignancy. Carcinoma, in contrast to tuberculosis, is friable, bleeds easily, often grows rapidly, invades the surrounding tissues, metastasizes early to the inguinal glands. A biopsy is many times the only means by which a differentiating diagnosis can be made. Novak feels that a study of the histopathology of the lesion is the only reliable method of diagnosis. Actinomycosis often resembles tuberculosis in its clinical manifestations but the purulent discharge is granular in appearance. These granules when examined microscopically may be readily recognized as actinomycotic fungi bodies. Esthiomenus is characterized by an extensively swollen and discharging ulcer of the vulva. According to Gallagher the etiology is not clear but is generally believed to be that of tertiary lues. No *Spirochaeta pallida* have been found however. It often simulates cancer and lupus.

#### TREATMENT

The treatment of this serious ailment has almost as many variations as it has observers. No one method of treatment is at all satisfactory for the disease is very difficult to treat with permanent results. Conservative and non-operative methods almost invariably fail as do also the more radical surgical measures. Cullen used radium x-rays with no improvement. Cautery has seldom helped. Excision of the ulcer and of the involved inguinal glands under local anesthesia is usually the method of choice although this procedure has met with many failures. Frequently surgical removal has hastened rather than checked the dissemination

of the disease. Dr. Henry Schmitz recommends the use of ultraviolet rays as a useful adjunct in treatment. Halsted recommends a careful coordination of both medical and surgical aspects in the treatment of this disease.

#### CASE REPORT

The following case is of considerable interest because of its duration and of the difficulties attending its diagnosis:

Mrs. R. D., housewife, aged forty-four entered the hospital May 18, 1928 complaining of weakness, loss of control of the bowels, and a painless discharging ulcer beside the vulva. The admitting diagnosis was carcinoma of the rectum and vulva with metastases to the liver.

*Family History.* Father, age and cause of death is unknown. Mother, age unknown, died of stomach trouble. There is one sister alive and well. There is no history of tuberculosis in the family.

*Past History.* The patient has always been healthy until the present illness. She has never had pneumonia and to her knowledge has never been exposed to tuberculosis. She has not been subject to coughs or sore throats. The menstrual history is insignificant, the periods having been regular up to about one year prior to admission. Since then they have been quite irregular with little or no pain. The last period was about 3 months previous. There have been no miscarriages and no children. The bowels have been regular up until the present illness. There have been no urinary disturbances nor any operations.

*Present Illness.* The patient states that her present trouble began about three years ago with severe constipation. The condition lasted a few weeks then quite suddenly she noticed that she no longer had control of her bowels for a period of several weeks. Since then there have been alternate periods of constipation and diarrhea, unattended until recently with pain. Recently the uncontrollable bowel movements have been accompanied with considerable bleeding. Her appetite has been quite good although she has lost considerable weight. She has never been jaundiced. There has been no vaginal discharge. Her weakened condition has compelled her to remain in bed for most of the time during the month prior to admission.

**PHYSICAL EXAMINATION.** The patient is a small emaciated looking white woman of about forty-five years of age. She is sitting up in

are of good quality, rate and rhythm. The blood pressure is 112/68.

**Abdomen.** The abdomen is scaphoid. There

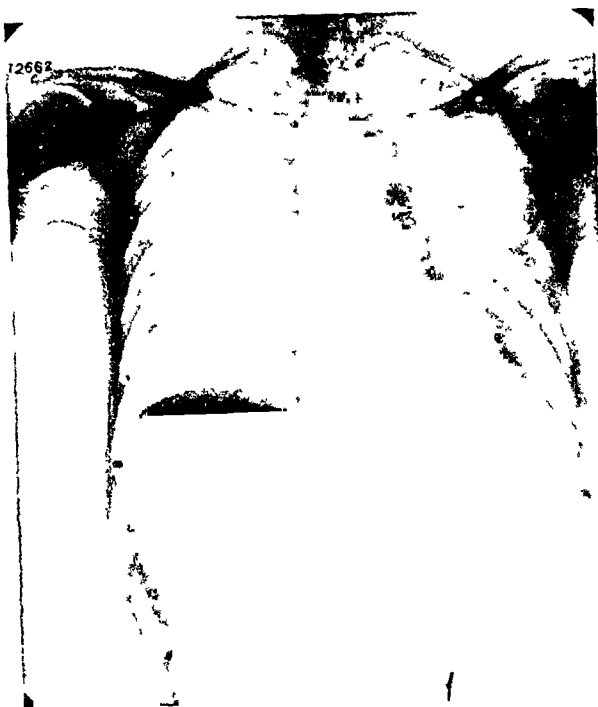


FIG. 1. X-ray photograph of Mrs. R. D.'s chest. Shows few discreet fairly well-circumscribed areas in both apices. These are probably healed tuberculous areas.



FIG. 2. X-ray of pelvis showing evidence of malignancy. Incidentally it does show comparative size of right and left labia majora. Left side is shown as extremely enlarged.

bed and apparently not in any pain or distress. Her temperature is 99.8°F.; pulse 100; respiration 20. There is a sparse growth of dry hair on her head which is otherwise negative.

**Eyes.** The movements are normal, there is no nystagmus. The pupils react sluggishly to light and accommodation. The sclera is clear and the conjunctiva pale.

**Nose.** Negative.

**Mouth.** The mouth shows many decayed teeth and considerable pyorrhea. The breath is fetid. The mucous membranes are pale, the tongue is coated and the tonsils are small and buried. The posterior pharynx is negative.

**Neck.** The neck is slender and shows pulsations and no enlarged thyroid. The lymph glands are barely palpable.

**Chest.** The chest is extremely emaciated but symmetrical. The breasts are atrophied and soft. There are no palpable glands in the axillae. There is good expansion of the lungs with equal displacement at the bases. The lungs are resonant throughout, there are no râles.

**Heart.** The heart is normal in size, the P.M.T. well within the nipple line. The sounds

are no masses felt, no tenderness and no rigidity. The liver, spleen and kidneys are not palpable. There are indurated but not tender glands the size of an almond in each inguinal region.

**Rectum and Genitalia.** There is pus exuding from the rectum. There is loss of sphincter tone. About 1 in. up from the anal orifice there is an annular mass constricting the rectum. It is firm, nodular, has little tenderness and shows little tendency to infiltrate into the surrounding tissues. There is a nodular mass involving the left vulva and perineum. The ulcer has a granulating base and shows little tendency to bleed. The edges are irregular and somewhat excavated.

**Extremities.** The extremities are normal in appearance except for emaciation. The reflexes are normal to hyperactive.

**LABORATORY REPORTS.** *Urine.* Non-catheterized specimen. Amber. Sp. Gr. 1.012. Reaction, neutral. Albumin, negative. Sugar negative. Microscopical, white blood cells, many red blood cells. Six to 8 high power, many bacteria, many epithelial cells, few hyaline and granular casts.

**Blood Count.** Hb. 55 per cent Dare. R.B.C. 4,620,000. W.B.C. 5050: polymorphonuclears

60 per cent, small monocytes 22 per cent, large monocytes 13 per cent, eosinophiles 3 per cent, basophiles 2 per cent.

deeper tissues are infiltrated with leucocytes both polymorphonuclear and mononuclear together with a number of plasma cells. The



FIG. 3. Photomicrograph of section of tissue taken from hypertrophic area of labia majora. Magnification  $\times 150$ . Section shows papillary hypertrophy of cutis and widening of lymph spaces with areas of round-cell infiltration.



FIG. 4. Magnification  $\times 450$ . Area shows ulcerated surface with walls edematous, widened lymph spaces, round-cell infiltration, plasma cells and some hemorrhagic infiltration. There is considerable proliferation of epithelioid cells.

*Wassermann.* May 24, 1928 negative. June 18, 1928 negative. June 25, 1928 negative. July 7, 1928 negative. The last three tests were made following provocative treatments.

*X-ray.* Posterior-anterior x-ray of the chest May 28 and June 30 showed areas of increased density in the apices of both lungs. The areas had the appearance of old healed scars. (See Fig. 1.) X-ray of pelvis showed no malignancy of the bony pelvis (Fig. 2).

*Microscopic Smears and Biopsies.* May 28, 1928. Microscopic smears from the ulcer and pus from the rectum were negative for *B. tuberculosis*. The interne reported insufficient pus for guinea-pig inoculation. Pus showed no intracellular gram negative diplococci nor actinomycotic granules.

May 28, 1928. Specimen taken from the left labia and edge of the ulcer. Report shows section of skin and subcutaneous tissue. The

lesion is an inflammatory one without evidence of malignancy. (See microphotograph, Fig. 3.)

June 6, 1928. A biopsy specimen from another hypertrophic area shows extensive round-cell infiltration and has no tendency to vascular grouping. Diagnosis: chronic ulcerative inflammation. (See Fig. 4.)

June 28, 1928. Biopsy of a left inguinal gland shows numerous microscopical areas of caseation with accumulations of lymphocytes, epithelioid cells and many typical giant cells. Diagnosis: tuberculous lymphadenitis. (See Fig. 5.)

June 29, 1928. Spinal puncture showed spinal fluid clear with a cell count of 4 per cubic millimeter.

July 17, 1928. A guinea pig was inoculated with pus from the ulcer. Report of August 27, 1928: guinea pig positive for tuberculosis.

**DIAGNOSIS.** An exact and immediate diagnosis was difficult in this case because of its

similarity to several other diseases. The following impressions and consultant opinions were made:

May 22, 1928: (1) Tuberculosis vulva, perineum, and rectum.

(2) Syphilis, tertiary stage.

(3) Carcinoma.

(4) Actinomycosis.

Surgical and dermatological conferences were asked for.

*Surgical.* May 23, 1928: Appears like tuberculosis or carcinoma. June 1, 1928: History suggestive of malignancy but rectal mass has not the consistency of a malignant mass. Laboratory diagnosis necessary.

June 28, 1928: This condition is syphilitic and advise antisiphilitic treatment and biopsy of inguinal gland.

*Dermatological Impressions.*

June 1, 1928: 1. Carcinoma.

2. Syphilis.

3. Tuberculosis.

4. Granuloma annulare.

Requested smears for tuberculosis and Donovan bodies, also therapeutic test for syphilis.

*Final Diagnosis.*

July 6, 1928: Ulcerative and hypertrophic tuberculosis of vulva and perineum, determined by examination of pathological specimens obtained from a series of biopsies.

*PROGNOSIS.* The prognosis of the patient is very grave because of the poor appetite, the progressive emaciation and weakness and the increase in size of the involved area. The long duration of the disease with the progressive loss of weight and strength has left the woman in a very serious condition and there is apparently no resistance left for fighting the infection.

*TREATMENT.* Surgery is certainly contraindicated, thus leaving medical care the only alternative. Symptomatic and hygienic treatment were given such as rest in bed, sunshine and plenty of fresh air. Cleansing douches of potassium permanganate 1:1000 solution were used on the ulcer. Codeine and luminal were administered for pain and restlessness as was deemed necessary. Seven doses of neoarsphenamine, ranging from 0.3 to 0.6 gm., a total of 3 gm., distributed over a period of one and one-half months were administered intravenously. This was ordered by the dermatologist first for diagnostic and later for therapeutic reasons. It was considered that the patient

showed some improvement and the neoarsphenamine was thereby indicated.

*CLINICAL COURSE.* Mrs. D. was sent to



FIG. 5. Microphotograph of inguinal lymph gland. Case of Mrs. R. D. Magnification  $\times 80$ . Section shows considerable proliferation of epithelioid tissue with goodly number of giant cells.

the hospital May 18, 1928 because of her failing health and ulcerous condition of the vulva. After entering the hospital her condition continued on a downward course. It was thought for a time that there was a slight improvement due to the neoarsphenamine injections, but the response was only very slight and temporary. July 7, 1928 she became delirious but this condition cleared up within twenty-four hours. Her weakness and anemia progressed. Her temperature ranged from  $97^{\circ}$  to  $102^{\circ}\text{F}$ . Food could not be retained and she passed away in coma August 1, 1928.

*AUTOPSY REPORT.* The body is that of an emaciated white woman about forty-five years of age. There are no scars on the head, chest nor abdomen. The extremities are negative. There is a discharging, ulcerated, and indurated mass involving both labia majora and minora and extending bilaterally to both sides of the sphincter ani. This mass extends laterally

about 5 cm. over the right buttocks, it also surrounds the meatus but does not involve the mons veneris. The brain shows a slight edema. The cerebral spinal fluid is cloudy but no B. tuberculosis are demonstrable. There are no hemorrhagic areas.

The thoracic and abdominal contents were exposed through the usual midline incision. There is no excess of fluid in either body cavity. There are fibrous adhesions of the apices of both lungs to the thoracic wall. Macroscopic sections of the lungs revealed healed fibrous and calcareous areas but no active tuberculous areas. Microscopically the areas showed active tuberculous proliferation. The heart is normal in size with no lesions manifested.

There is no evidence of infection or malignancy in the viscera of the abdominal cavity. The liver shows some fibrosis and fatty degeneration. The spleen and kidneys are apparently normal in size showing no areas of infection. There is a stricture of the rectum about 7 cm. from the anus. There are enlarged nodular epiploicae continuing to within 20 cm. of the ileocecal valve.

*Diagnosis.* 1. Possible beginning tuberculous meningitis.

2. Tuberculous vulvitis with extension to the inguinal lymph nodes and rectum.

3. Macroscopically the lungs showed apparently healed tuberculosis of both apices. Microscopic examination showed active tuberculosis of these areas.

4. Fibrosis of liver with fatty degeneration.

#### COMMENT

This case bears out the findings previously described by others and referred to in this paper, namely prolonged duration of illness, progressive emaciation and

weakness, and manifesting difficulties in diagnosis and treatment. A wider study of the case discloses a discrepancy in diagnosis and one for which we should criticize ourselves, and that is the omission of an early guinea-pig inoculation test. No doubt the time for arriving at a diagnosis could have been shortened by at least six weeks by this procedure. However, the fact still remains that clinical and pathological diagnosis of tuberculosis of the vulva may require considerable time and repeated biopsies.

#### CONCLUSIONS

1. Primary tuberculosis of the vaginal tract is rare, due to the resistant qualities of the epithelial covering.

2. Differential diagnosis of tuberculous vulvitis and vaginitis requires careful observation and may also require many laboratory tests, including biopsies and guinea-pig inoculation.

3. Most cases of tuberculosis of the vaginal tract are complicated by tuberculous foci of infection in other parts of the body.

4. The prognosis of tuberculosis of the vaginal tract is exceedingly grave.

5. Treatment to date has been very unsatisfactory. It must of necessity include the best of medical care in addition to rest, air, food and sunshine. Surgery may be a useful adjunct providing the focus of infection is localized to a small area and the patient's health is not too severely depleted. Surgery has no advantages in disseminated cases. Cautery should be considered in small areas of accessible foci.

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# MEDIASTINITIS FOLLOWING REMOVAL OF THYROID\*

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**M**EDIASTINITIS is not infrequent, but is as a rule not recognized as such, which is probably due to the fact that it arises as a complication of some process elsewhere whose symptoms mask those of this condition itself.

The mediastinum is a closed space, therefore is a difficult space to drain either by nature or by operative means so that extension of inflammation to vital structures is apt to take place.

In inflammations of the neck, in which group this case report belongs, mediastinitis is rare (that is, if the inflammation arises in the superficial tissue) as the downward path is well guarded by fascia, whereas in the deeper regions, especially along the larynx, trachea and esophagus, extension is easier, but this being the case the inflammation must extend to the deep cervical fascia from whence it passes into the mediastinum.

An exhaustive search of the literature has not disclosed a similar case on record; therefore the following case history is submitted:

H. A., female, aged 56, was first admitted to the hospital November 2, 1927, complaining of a large hard mass in the neck, loss of weight, weakness, choking sensation and shortness of breath. The history was that she had had a hard mass in the neck for seven years, but during the past three months it had become markedly larger. The choking sensations and shortness of breath had only been noted for about 4 months. She stated that she had lost about 45 lb. in a year.

Physical examination revealed a fairly well nourished female, bronzed and rather toxic. Neck: A large mass was present in midline, extending laterally (bilateral), which moved with deglutition; mass was nodular and extremely hard, appeared rather fixed. Heart: Both sounds were present over the apex and

aortic region, rate was fair, fibrillation and a systolic murmur were present. The hemoglobin was 80 per cent, erythrocytes numbered 4,050,000, leucocytes 9000, polymorphonuclear leucocytes 73, lymphocytes 23, large lymphocytes 4 per cent. The urea-nitrogen was 19.62 mg., creatinin 1.2 mg., sugar 88 mg. The Kahn test was negative. The basal metabolism reading was plus 1. Urine: specific gravity 1.020, acid reaction, light cloud of albumin, occasional leucocytes, hyaline casts. A diagnosis of carcinoma of the thyroid was made.

The patient was placed on the routine preliminary treatment and five days later maximal subtotal thyroidectomy, consisting of excision of isthmus and both sides, was done by Dr. S. J. Waterworth. Tracheotomy was also done following removal.

*Operative Record.* The carcinomatous mass, very large and extremely hard, had pushed the trachea to the left in the form of the letter J. The carcinomatous mass was attached to the common carotid sheath. In following the carcinoma over the isthmus it was found that the anterior wall of the trachea had been invaded and a tracheotomy was done, a long Jackson tracheotomy tube being used. As nearly as possible all vestige of carcinomatous tissue was removed except that of the anterior wall of the trachea. In order to remove this, it would have been necessary to remove the anterior half of the trachea over a distance of about 3 in. of its length.

*Pathological Report.* Specimen of complete thyroid, measuring  $3 \times 7 \times 4$  cm.,  $7 \times 6 \times 4$  cm.,  $5 \times 4 \times 3$  cm. and five other smaller pieces. The cut surface was yellowish white, hard, rather uniform with a few hemorrhagic areas. All tissues showed similar gross appearance, except one small nodule that appeared to be more colloidal.

*Microscopic Report.* Section consists of almost solid masses of large cells like thyroid, but are large. Some contain vacuoles of colloid material. There is a lobulated arrangement of the cells.

*Diagnosis:* Carcinoma of the thyroid.

Following the operation she had a moderate

\* From the Department of Surgery, Clinic of Dr. S. J. Waterworth, Clearfield, Pa.  
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postoperative reaction, temperature never reaching above 103.2°F. (rectal) and was within normal limits in about 8 days. The tracheotomy



FIG. 1.

tube was changed several hours each day. Three days later it was left out entirely and the wound was allowed to heal. On the twenty-eighth day following admission the patient was discharged with thyroidectomy wound almost closed. Her general health had improved. She was advised to return every month for a check-up examination on her condition.

She returned several times, after which she was not seen until a year had passed. She was then admitted to the hospital for the second time, with a history of having lost weight for eight months. She had considerable irritation in the neck with choking which made it impossible for her to sleep. At this admission the patient was emaciated, bronze colored and felt very much depressed. Examination of neck revealed a hard mass on the left side of the trachea. Two days later an operation was done<sup>1</sup> with the following report: excision of all carcinomatous tissue which, on the left, extended behind the trachea involving the esophagus. A small area of the esophagus was caught with the artery forceps in dissecting, but apparently was not punctured. The area was turned in with catgut sutures. Dissection was very difficult and was attended with great anterior hemorrhagic oozing which was controlled with

<sup>1</sup>By Dr. S. J. Waterworth

cautery, suture and packing. In dissecting off the carcinomatous mass of the trachea, the anterior portion of trachea, the second and third tracheal rings had been absorbed, carcinomatous tissue growing within the lumen of the trachea. A long tracheotomy tube was introduced and the wound was packed with acriflavine gauze, skin flaps partially closed over gauze.

*Pathological Report.* Carcinoma of thyroid (recurrent).

Following this operation she had a moderate postoperative reaction. The temperature reached 103.4°F. (rectal) and on the third day began coming down. The tube was changed daily and considerable mucus was present, hence a catheter was placed through the tube, which was in turn connected to an aspirating apparatus. About every two hours aspiration was carried out. The wound was kept antiseptized as best as it could be, but due to mucous coming in contact with it a slight infection occurred and immediately the temperature jumped several degrees. In two days it was noted that a small opening was present which extended downward into the mediastinum. A catheter was placed in the sinus tract and a quantity of pus aspirated. This was carried out several times a day. The temperature during this time ranged between 100.4 and 105.2°F. (rectal). The third day following aspiration of pus, Dakin's solution was used for irrigation. This treatment caused the fever to drop several degrees. Two days later she began having severe pain in the chest with shortness of breath. This was followed by a rise in temperature to 106°F. (rectal) which fell to normal the next morning. That afternoon sodium iodide was passed through the catheter within the sinus tract and a roentgenogram was made,<sup>2</sup> following which fluid was again aspirated. After this procedure the patient rested well until several hours later when she began complaining of severe pain in the chest which radiated to the suprasternal notch. The pain lasted for about two minutes, then suddenly she ceased to breathe. Artificial respiration was resorted to but without avail. No autopsy could be obtained, but the roentgenogram will prove the diagnosis.

<sup>2</sup>By Dr. W. E. Reiley.



# FOREIGN BODIES IN THE BRAIN\*

LEO DRETZKA, M.D., F.A.C.S.

DETROIT, MICH.

ALTHOUGH brain surgery, we learn from archeologists, is as old as any branch of the science, it is only since the development of the roentgen-ray and the fluoroscope that the surgeon has been equipped to invade with any degree of certainty the innermost domain of personality and of life itself. The experience gained in the World War, when a vast amount of radical brain surgery was performed, has greatly enhanced our knowledge of what can be done within the cranial vault. It has given the surgeon a new boldness for emergencies, it has drawn with greater precision the line beyond which we may not venture.

Our great cities send to the operating tables a stream of casualties not unlike those moving back from a relatively quiet sector during the war. The injuries of industry, of traffic, and of crime all include a high percentage of cases in which penetration of the brain by foreign bodies is to be suspected.

Any injury to the head suggests the possibility of a foreign body in the brain. Not infrequently an uneventful recovery from a seemingly trivial head injury is followed in after years by brain abscess, migraine, vertigo, mental confusion, epilepsy, extreme lassitude and other symptoms originating in mechanical interference with the functioning of various parts of the brain.

These notes are based on a personal study of 2308 head injuries admitted to the Receiving Hospital of the City of Detroit during a four-year period. Of this number, 1662 were fractures and 62 were wounds caused by missiles or weapons.

It is imperative in every case of brain injury to proceed as rapidly as possible with a complete fluoroscopic and roentgen-ray examination, made with exacting

care by a trained expert. If the case presents itself at any distance from the facilities for such examination, it should be transported to the proper place as soon as shock has been overcome sufficiently to make such a move safe. Next in importance, and never to be neglected, is a neurological examination, conducted by a specialist in that field.

Before entering upon a discussion of certain types of brain injuries in which foreign bodies are involved, it is well to meet fairly the question as to just what conditions indicate the necessity of operation. It is true that very often foreign bodies may become encapsulated and cause no radical symptoms immediately. It is, therefore, natural for the surgeon whose practice does not include a large number of brain traumata to follow the course that seems safest at the time. This is probably a logical decision if there are not available the very best aids, both human and mechanical, to insure the success of an entrance into the deep tissues of the brain. But where such aids are available, it is best to clear away at once the possible causes of accumulative complications which may lead to the gravest consequences.

In examination of brain injuries involving foreign bodies, it should be borne in mind that seldom is there a single well-outlined object to be sought. Penetration of the hair layer, of skin and bone and sometimes of some form of headgear, is likely to carry with it skull splinters and fragments of the missile itself, together with a trail of other material potentially infective.

## THROUGH-AND-THROUGH WOUNDS OF THE CRANIUM

Systemic shock is, of course, terrific

\* Submitted for publication September 10, 1929.

in a through-and-through penetration and urgent attention to general resistance is of first importance. The wounds of entrance

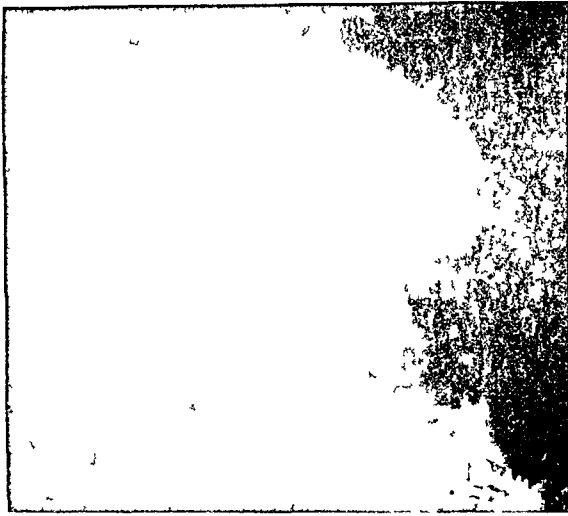


FIG 1 W. L., F. 987, aged forty. Kicked and stabbed. Roentgen-ray shows  $\frac{1}{2}$  in. point of knife blade embedded in median line of frontal bone with linear fracture 1 m. in length about 4 m. above glabella. Recovery. Knife blade removed by operation

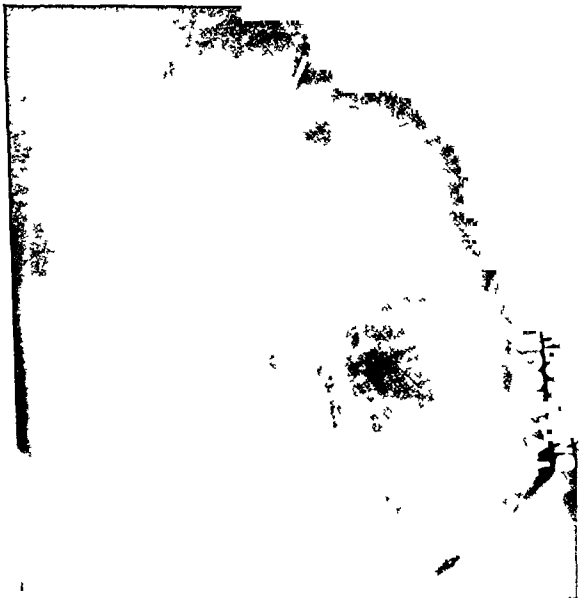


FIG. 2 Shows knife blade illustrated in Figure 1. Viewed in this position, it may be interpreted as foreign body in brain and not embedded in skull bone.

and exit are shaved and thoroughly cleansed, and asepsis maintained, without any effort either to install drainage or to close the wounds. As soon as it is practicable, roentgen-ray examination should

be made to determine whether any foreign matter has lodged in the pathway of the wound. If the examination is negative, the wound of entrance should be excised sufficiently to assure the removal of infected and damaged soft tissue. Then the bony opening must be enlarged to expose healthy dura. The ragged edge of the dural wound is also trimmed away and the cortical lesion treated as indicated in the individual case. This will also assure natural drainage. It is not necessary to excise the wound of exit.

#### FOREIGN BODIES IN THE BRAIN

A foreign body, or a group of them, having been located within the brain and the advisability of removal determined upon, preparations for the operation should include the fluoroscope and electro-magnet, both of which are to be in readiness for instant use. It should be borne in mind that while the lead cores of modern



FIG 3 E. S., F. 5851, aged thirty-three. Shot in quarrel. Roentgen-ray shows fracture of left temporal bone. There is also evidence of gunshot fracture of left orbit. Numerous metallic fragments embedded in outer margin of orbit. One large fragment appears to be partially in left sphenoidal sinus. Discharged, recovered, ten days later. No symptoms.

bullets will not respond to the magnetic pull, the alloy jackets, which often are stripped from the core and left in the

wound, frequently behind the bullet, sometimes beyond it, or flung off at angles to its course, are attracted by the magnet.

### COMPLICATIONS

It is to avert complications that the radical procedure of removal of all foreign

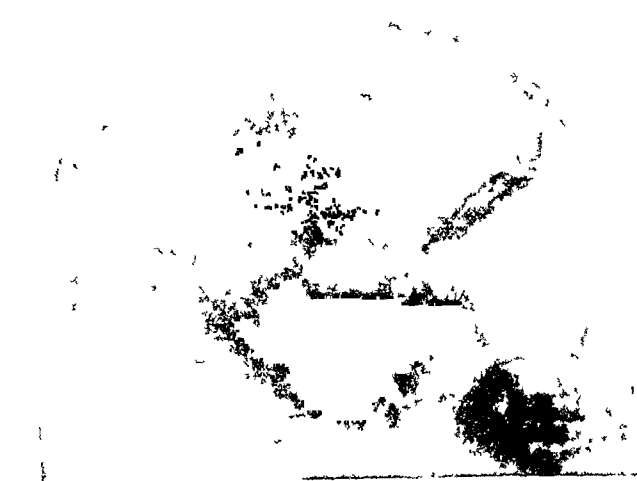


FIG. 4. J. P., F. 4586, aged twenty-eight. Shot trying to stop fight. Roentgen-ray shows opaque shadow, shape of bullet, which is just above right mastoid within skull. Discharged, recovered, sixteen days later. No symptoms. No operation.

The majority of foreign bodies are, however, removed by direct operation. If the wound of entrance is to serve as the path through which the foreign body is to be extracted, then the surgeon must enter it with care, giving all his attention to the aseptic cleansing of the tract of foreign material.

Local anesthesia is invariably preferable. It enables the surgeon to work without the interference of the mask, and does not tend to upset the balance of vitality, which may be very delicate in any case of gross injury to the brain.

*Hemorrhage.* It is frequently imperative that immediate attention be given to the control of severed blood vessels or sinuses and that the removal of the missile be delayed until some more opportune time. A bullet or fragment of bone may penetrate the sinuses, most frequently the longitudinal on account of its exposed position. Hemorrhage from the middle meningeal arteries must be immediately controlled by ligature. Frequently, however, the missile or bone fragment lies in the direct field of operation and is readily removable.

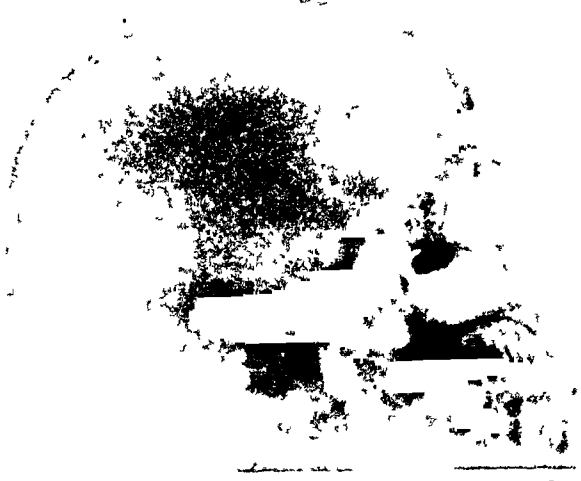


FIG. 5. Bullet which lies posterior to right ethmoidal cells. Large fragment to right margin of orbital ridge. Also minute fragments within region of right orbit.

objects is advised. The most scrupulous adherence to surgical asepsis is, obviously, required, with meningitis as a routine outcome of infection.



FIG. 6. Bullet in lateral aspect of right orbit which has fractured lateral orbital rim.

*Drainage.* There is no hard and fast rule regarding drainage. When it has been possible to remove foreign material, and pulped brain tissue, and the oozing has ceased, then a rubber wick at the extreme angle of the wound is usually sufficient.

In the presence of pus deeper drainage is necessary. Hard rubber tubes must never be employed. Drainage is to be continued

in the absence of focal symptoms, it is difficult to make a definite diagnosis. After the abatement of the acute symp-



FIG. 7. Bullet  $1\frac{1}{2}$  in. to left of median line and  $\frac{1}{2}$  in. above line drawn between auditory canals. It is  $\frac{1}{2}$  in. posterior to clinoid process.

until all oozing has ceased or bacterial examination warrants that it be discontinued. Irrigation of the wound with warm saline often facilitates drainage.

Abscess is usually a rather late consequence of a foreign body within the brain. Although it is usually averted by the complete removal of the foreign matter, there is always the likelihood that it will occur even after that has been accomplished. Headaches, repeated rises in temperature, mental dullness, point to the possibility of abscess.

About 15 per cent of brain abscesses are traumatic. The usual causes are fractures of the vault infected from without, or a foreign body penetrating through an infected sinus. A traumatic abscess is usually in the direct line of the original injury. It may be free or it may be encapsulated and it is usually single. When in the motor cortex, it often induces epilepsy.

I find it convenient in classifying symptoms, to divide them into acute, dormant and exacerbating types. The acute type has an almost immediate progressive onset: the fever is high and accompanied by delirium, anorexia and vomiting. This type resembles a purulent meningitis, and



FIG. 8. A. P., F. 1500, aged thirty-three. Complaint was headache back of left ear and periodical attacks of blindness. Was shot in hold-up three years previous and after being confined to hospital for twenty-one days was discharged. Since then has become progressively worse.

Roentgen ray shows oblong opaque shadow within cranial cavity on left side on line with upper border of mastoid. Also small opaque shadow embedded in soft tissue.

Operation: Local anesthetic 1 per cent novocaine. Debridement was done at site of entrance. Skull was thickened at place of entrance. Dura was incised and bullet found lodged  $\frac{3}{4}$  in. beyond cortex. It was completely encapsulated.

Discharged recovered, without symptoms, twelve days after operation.

toms, drowsiness, stupor and coma set in. The pupil on the side of the abscess may be dilated and fixed.

In the dormant type, an abscess may remain dormant for years and produce only such vague symptoms as headache, mental dullness and impairment of vision, as witness Case 1:

CASE 1. J. B., a southern negro, who had passed the draft board and was in an embarkation camp ready for overseas duty. The strenuous drilling caused him to complain of severe headaches and he was removed to the base hospital for observation. Several days after admission, he began having convulsions which increased in severity. His neurological examina-

tion was quite negative, as was his history. A roentgen-ray examination of the skull disclosed a knife blade  $1\frac{1}{2}$  inches in length

toms of the acute type. These symptoms are followed by convulsions, aphasia, monoplegia or hemiplegia. The localizing



FIG. 9. Bullet in lateral aspect of right orbit which has fractured lateral orbital rim.

penetrating the occipital bone and extending into the brain. More careful questioning helped him to recall a fight about ten years previous to this time, in which knives were used as weapons, but there was no disability at the time and he had engaged in his regular employment all these years without the least discomfort or the knowledge of the knife blade in his brain.

Operation for brain abscess and removal of knife blade; left occipital region. A large encapsulated abscess was evacuated. The walls of the abscess were extremely thick and the cortex destroyed. Irrigations but no drains were used. Exposure of the cavity was done by removing a large area of bone overlying the abscess. No brain hernia resulted. Complete recovery.

It is this type which is so frequently found at autopsy.

A history of previous injury usually accompanies the exacerbating type. The patient has apparently recovered from a skull injury when suddenly a high fever and leucocytosis sets in with all the symp-



FIG. 10. Knife blade removed from brain. It was surrounded by cortical abscess. Recovery.

ptoms, either spasmodic or paralytic, indicate the center which is irritated and destroyed, as witness Case II:

CASE II. I. L., admitted to the hospital Sept. 19, 1924, following, an automobile accident. He was semiconscious and restless. There was an abrasion and contusion of the left face and scalp, and a slowly oozing hemorrhage from the nose and mouth. His lower jaw was fractured. The pupils were unequal, the left being larger than the right. Roentgen-ray examination of the skull was negative.

September 24. Entirely unconscious and delirious with no paralysis.

October 2. Condition improving. There was a return to consciousness, but a typically septic temperature. At this time, a purulent discharge of the left ear evidenced itself, which the aurist pronounced an otitis media.

Neurological examination disclosed a partial paralysis of the right arm and leg and left facial paralysis. Reflexes extremely active.

Diagnosis. Abscess of the brain, left temporosphenoidal region.

Operation. An elliptical incision was made and the skull exposed. A comminuted fracture of the petrous portion of the temporal bone was exposed. The loose fragment was removed and the defect enlarged. The dura was tense and there was no pulsation. Immediately on

incising the dura, the brain bulged into the wound. Thick staphylococcic and streptococcic pus escaped after the cortex was punctured. The opening was enlarged and a cavity the size of a hen's egg exposed. The patient made an uneventful recovery. There was no brain hernia.

An examination of the eye grounds often shows a retinitis due either to pressure or to toxemia.

Abscesses develop more frequently in the white matter of the brain because this is less resistant and liquefies more easily than the cortex upon which the pus accumulation impinges.

Recent abscesses contain colored pus and later this pus becomes greenish. Staphylococci and streptococci are the organisms most frequently found in traumatic cases.

*Epilepsy* sometimes occurs as a sequel of penetration of the brain by a foreign body. Site of the injury seems to have no special bearing on the occurrence of this condition, nor have we any adequate amount of material on which to base conclusions regarding preventive measures. The follow-up of brain injury cases, occurring as they do in the big industrial centers for the most part, is unsatisfactory.

Check on patients seemingly recovered is impossible. We, are however, justified in assuming that prompt and effective removal of all foreign bodies from the brain vault is a precaution materially tending to decrease the likelihood of the epileptic complication.

#### MORTALITY

High mortality in injuries of the brain itself must be expected. This is an argument for, rather than against, the courageous attempt to avert disaster in the event the patient is destined to survive. Of course, there are brain areas whose penetration must result fatally.

#### POSTOPERATIVE CARE

After operation the patient should be propped up in bed and the head covered with ice bags. Morphine should be given every five hours for several doses to insure rest and quiet. Bromides may be used during convalescence if indicated. The possibility of infection is the most serious complication which the surgeon must look for: a rise in temperature, delirium, vomiting, muscular twitching or neck rigidity indicates its onset.



## UTERINE POLYPOSIS

### MALIGNANT TRANSFORMATION WITH PULMONARY METASTASES\*

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NEW YORK

THE several histologic varieties of cancer of the uterine corpus, with the exception of chorionepithelioma, are characterized by relatively slow destruction of the myometrium, late perimetritic lymphogenous metastases (as contrasted with rapid parametrial involvement in cases of cancer of the cervix), and abnormal bleeding or a thin leucor-

rhea as the earliest symptom. In the beginning of its progress, it can only be detected by microscopic examination of endometrial curettings. Hence, early diagnosis is predicated upon a diagnostic curettage, and a favorable prognosis is in turn dependent upon prompt recognition of the disease with immediate surgical intervention.

\* From the Department of Gynecology, New York Post-Graduate Medical School and Hospital. Read before the Section on Obstetrics and Gynecology, New York Academy of Medicine, May 28, 1929.

Although malignant polyps are said to develop from distended endometrial glands, the literature is not enlightening

the myometrium; (6) the tendency of corporeal cancer to metastasize to remote organs through the blood vessels instead

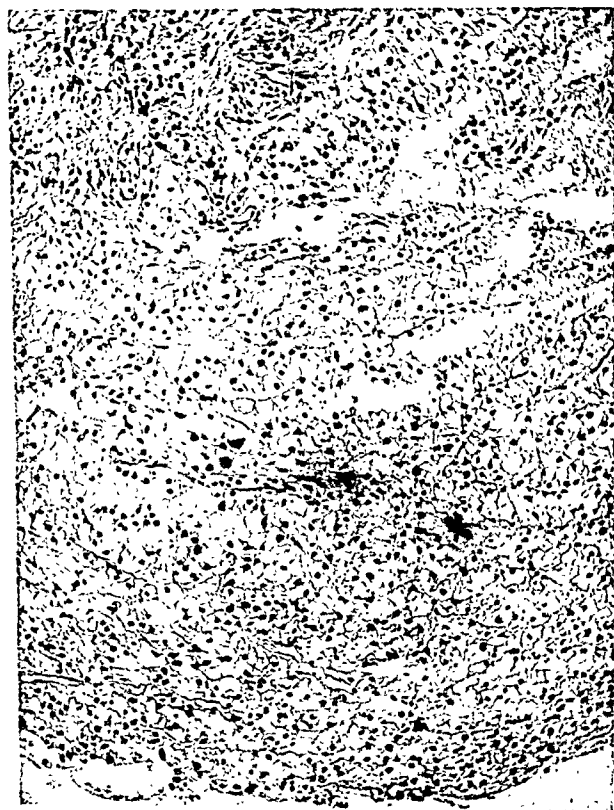


FIG. 1. Papillary projections of polyp protruding from cervix. Many layers of foamy polygonal cells with small dark nuclei are arranged around a thin central vessel.

concerning the tendency of benign glandular polyps of the fundus to undergo malignant transformation. The appended case report together with the histopathology of the specimen, exemplifies the following important points: (1) the metaplastic transition of a benign lesion of the endometrium into a malignant growth; (2) the inclination of some practitioners to perform a therapeutic rather than a diagnostic curettage for abnormal uterine bleeding; (3) the wisdom of removing the uterus for extensive uterine polyposis; (4) the long period of time that may elapse between the initiation of malignant disease of the uterine fundus and widespread destruction of the myometrium; (5) the pronounced proliferation of some papillary adenocarcinomatous growths, with comparatively slight infiltration of

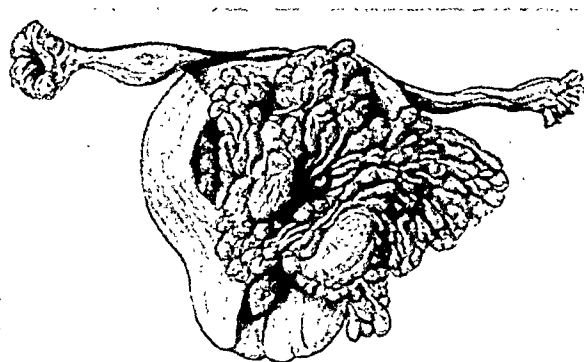


FIG. 2. Uterus opened, showing huge polypoid mass of friable adenocarcinomatous tissue.

of through the lymphatics, probably because after the climacteric the lymph channels become small and their circulation inactive; and (7) the impotence of the pelvic surgeon to save life when such metastases are already present.

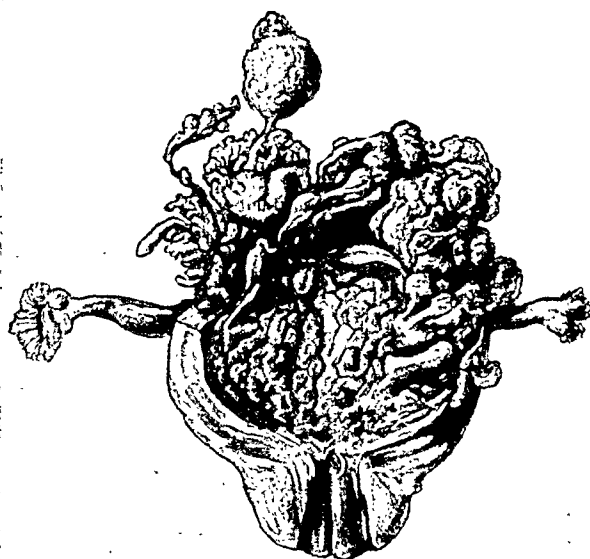


FIG. 3. Bulk of adenocarcinomatous mass has been elevated, to demonstrate cornual attachments, remarkable normality of most of myometrium, and extensive endometrial polyposis, many areas of which are still benign in character.

#### CASE REPORT

Mrs. E. B., aged sixty-three residing out of the city, with an irrelevant family and previous personal history, was referred by her physician on March 19, 1928. She had menstruated at fourteen, married at seventeen,



had one normal labor in her early twenties, and passed through an uneventful menopause at forty-nine. Pelvic symptoms appeared for



FIG. 4. Infiltration of endometrium with tremendous number of plasma cells. Endometrial lining is metaplastic cuboidal epithelium. There are irregular groups of "benign" glands, also with metaplastic epithelium.

the first time three years previously, when she noticed a little watery vaginal discharge, spotty bleeding, and occasional shreds of tissue. During this three-year period she was curetted twice by two different physicians, but neither one saved or examined the curettings.

The patient was a well-nourished, robust, elderly woman. There was no evidence of anemia or cachexia. Pulse 72, blood pressure 132/82, blood count and blood chemistry normal. Thyroid normal, heart sounds good, lungs clear, and abdominal examination negative. There was a moderate degree of cystocele and rectocele. A pedunculated mass with a necrotic surface, about the size of a walnut, projected from the cervix. The uterus was symmetrically enlarged but did not feel unusually hard. The adnexa were normal.

The patient deferred entering the hospital for removal of the cervical polyp (which was presumed to be malignant), diagnostic curettage, and radium therapy, until April 10.

The laboratory diagnosis, made on the specimens submitted at that time, was papillary adenocarcinoma and chronic endometritis (Fig. 1). The report further stated: "the tissue is very necrotic and shows marked evidence of dissolution, surrounded by extensive necrosis and hemorrhage. Sections from the curettings show narrow glands, with normal epithelium, surrounded with lymphocytic infiltration, which is scattered in the dense stroma."

*Preoperative Histopathologic Diagnosis.* Chronic endometritis, polyposis and papillary adenocarcinoma.

*Operation.* The patient delayed re-entering the hospital until May 7, when a wide pan-hysterectomy was performed. Her convalescence was uneventful and she left the hospital on the fifteenth day.

*Pathological Report.* Uterus weighs 175 gm. It measures 14 cm. in length and 10 cm. in width. It is uniformly enlarged. The cervix has a normal vaginal collar of mucosa. Both tubes and ovaries are attached. Each tube is 11 cm. long and has a free fimbriated end. The tubal serosa is congested and covered with small cyst-like growths, varying from 2 to 4 mm. in diameter. The tubal lumen is narrow and seems to be free. Both ovaries are similar, measuring 4 cm. in diameter, and are covered with normal whitish serosa. On section, diffuse fibrosis is seen, with some yellow remnants of corpus luteum.

On opening the uterus, the cavity is found filled with polypoid masses of friable tissue (Fig. 2). They break down easily. Some of them hang down from the fundus into the cervical canal. Filiform projections are distinct in some; in others there is much necrosis. Two larger masses are seen in each cornu, and these seem to be connected by chain-like extensions. The endometrium is cushion-like everywhere. There are numerous polypoid masses, and some of them have stems (Fig. 3). The polyps vary from 3 to 15 mm. in diameter. At the base of the tumor irregular extension of the growth is noted, but this does not penetrate more than 3 or 4 mm., and the growth is surrounded by at least 2 cm. of fibromuscular uterine wall, which is firm in consistency.

Sections show irregular islands of endometrium. In some places there is very rich inflammatory infiltration all along the surface of the endometrium, which seems to consist almost entirely of plasma cells (Fig. 4). The covering consists of metaplastic epithelium of rather low

cuboidal cells. In some places there are endometrial glands which are lined by one or more layers of cylindrical cells. There are no mitotic

serous cells. They contain homogeneous pink-staining substance.

*Pathological Diagnosis.* Chronic endome-

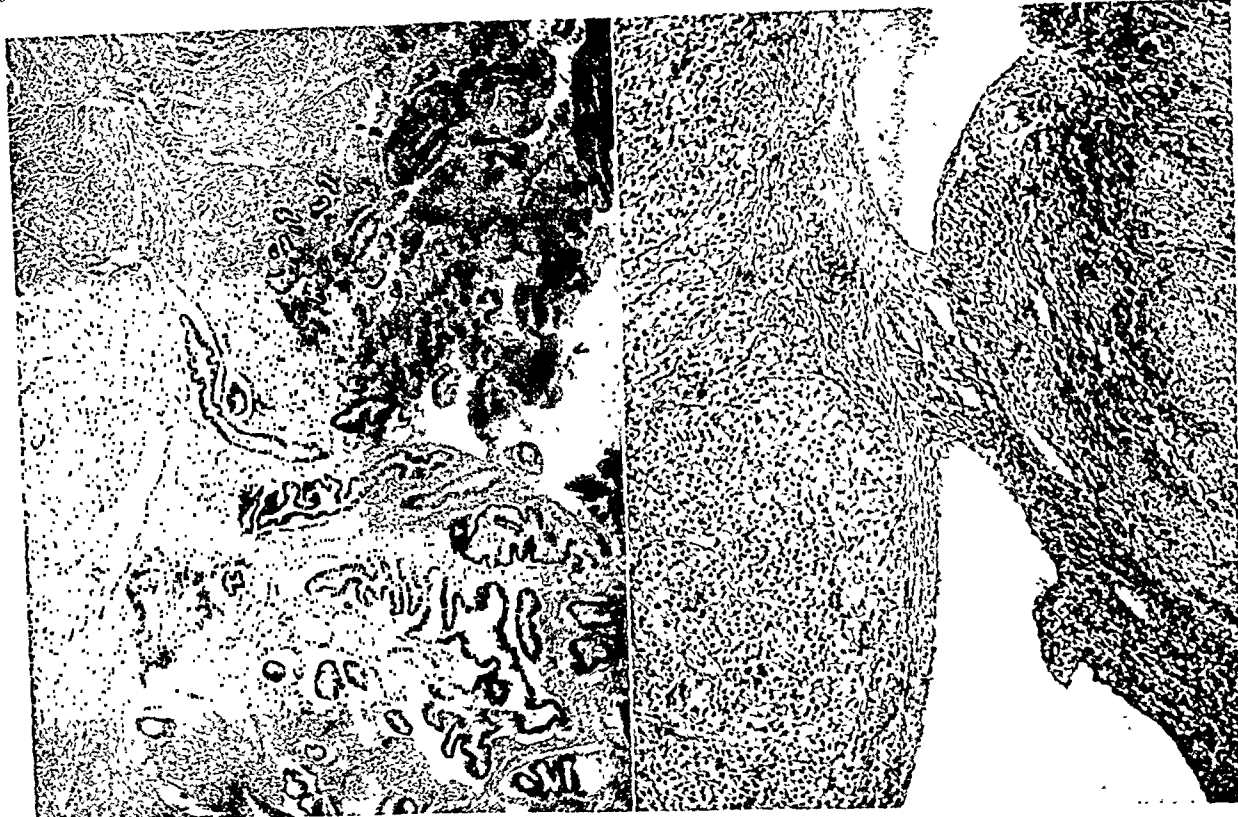


FIG. 5. Border of benign polypoid hyperplasia of glands and endometritis.

FIG. 6. Border of malignant polypoid growth of fundus, derived from metaplastic epithelium. Atypical adenocarcinoma of uterus.

figures in these areas, although the cells are irregular in shape and surrounded by typical stroma. Many areas show superficial erosions.

Sections of some polyps show hyperplastic glands with hemorrhagic stroma. These glands are surrounded with rich inflammatory infiltration of lymphocytes and plasma cells. No epithelial invasion is evident (Fig. 5).

In other sections, the base of the growth is seen, with atypical cells predominating. These cells are large and pale, and have small dark nuclei. A few mitotic figures are seen. The surface of these polyp-like outgrowths shows fine papillary projections, with stems of stroma in which there are many layers of similar large pale cells (Fig. 6).

Sections of the ovary show marked fibrosis and old hyalinized follicles. There is no evidence of metastatic growth.

Sections of the tubes show somewhat thickened folds with diffuse fibrosis. The blood vessels are congested and distended. The nodules on the serosa, seen in the gross, correspond to small cysts which are lined with flat

tritis with activity. Benign uterine polyposis. Papillary adenocarcinoma of the fundus uteri. Peritoneal cysts of the fallopian tubes.

*Pathological Note.* This growth is of the differentiated type and is probably of long duration. There is a very extensive diffuse endometritis of an almost pure plasma cell type, and there are multiple foci of glandular hyperplasia, which in some places form benign, and in others distinctly malignant, proliferation.

*Follow-up.* The patient reported on October 6, 1928, free from pelvic symptoms and apparently in excellent general condition. There was no evidence of local recurrence. The patient stated, however, that she had noticed occasional attacks of vertigo. Since she had not lost weight, and her pulse rate, blood pressure, and urine were normal, she was advised to return to her physician. A few days thereafter she developed an irritating cough, which could not be accounted for and which failed to respond to the usual remedial measures. An x-ray examination of the chest was therefore deemed advisable.

*X-ray Examination of the Chest.* Ventro-dorsal, dorsoventral, and right lateral views. Roentgenographic and fluoroscopic study.



FIG. 7. X-ray picture of chest, six months after hysterectomy. Adenocarcinomatous metastases in lung tissue are seen distinctly.

The chest is symmetrical. Right hilum moderately enlarged and thickened. A circular shadow of increased density is seen on the right side, having a diameter of  $1\frac{3}{4}$  inches. This involves the lung parenchyma, mesial first and second zones, slightly above the hilum (Fig. 7). Another circular shadow, much smaller and less dense, is seen on the left side in the infraclavicular region. There is a moderate amount of peritruncal thickening of the right and left descending bronchi. The heart is slightly enlarged to the left. Aortic arch not widened. Retrocardiac space is clear.

*X-ray Diagnosis.* Metastatic carcinoma of the lung.

*Progress.* The patient was sent to Florida for the winter. Her condition apparently

remained the same for a few weeks, but then became slowly worse, and she returned home on March 31, 1929. Another roentgenographic examination of the chest on April 2 showed various sized nodules throughout both lungs, characteristic of metastatic malignancy. The patient was drowsy much of the time, irrational occasionally, and extremely weak and emaciated. She coughed a great deal but did not suffer from pain. Death occurred on May 21, 1929, and an autopsy was refused.

#### COMMENT

The histogenesis of this adenocarcinoma of the uterus can be traced by the discovery of different areas in the extirpated specimen which still exhibit the several stages in the transformation of a benign process into one that is malignant. It seems logical to assume that the sequence of events consisted of: (1) severe inflammatory edometrial changes, (2) reparation, (3) overgrowth of glandular tissue, (4) polypoid formation, (5) malignant alterations in the surface epithelium, and (6) the development of papillary adenocarcinoma.

A correct diagnosis soon after the onset of symptoms by either of the gentlemen who curetted the patient, followed by immediate hysterectomy, might have anticipated the malignant process entirely, and thus precluded the remote metastases which rendered the delayed operation futile and caused the patient's death. The postoperative clinical history suggests the likelihood of cerebral as well as pulmonary involvement, and both of these were probably present when the patient finally came to operation. It is unfortunate that an autopsy was not permitted.



# RECTAL ADENOMATOUS POLYP

## WITH CARCINOMATOUS DEGENERATION\*

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MINNEAPOLIS, MINN.

A MARRIED woman, forty-nine years of age, complained of bleeding from the rectum for three or four months. Her husband and 3 children were well and there were no leading points with reference to her present illness in the family, social, occupational or menstrual anamneses. She has always been well except for an attack of measles and chicken pox. The physical examination was without the finding of pathologic anatomy except for the rectum. Here there was an adenomatous polyp, the size and appearance of a small raspberry,  $1\frac{1}{2}$  inches above the internal sphincter on the posterior wall. Examination of the remainder of the intestinal tract showed no other similar lesion and she was recommended to have this polyp removed.

On October 8, 1929, the polyp was excised with the removal and cauterization of the base. The first report made from the frozen section was that of benign tumor without degeneration. Subsequent study, however, revealed beginning carcinomatous changes in the base of the polyp; recommendation was made to sacrifice the anus.

She was placed on high caloric intake, mainly of fluid and semisolid nature and the colon was washed out twice daily. On October 11, 1929, a complete abdomino-perineal resection of the colon was performed. We were fortunate in securing an excellent induction of spinal anesthesia, so that the abdominal dissection was accomplished without inhalation anesthesia. The closure of the abdomen, and the perineal excision were done under nitrous-oxide-oxygen anesthesia. The postoperative condition was exceptionally free from violent reaction. No food or water were given by mouth for the first five days. During each twenty-four hours she was given 1 liter of 10 per cent glucose and 3 liters normal saline intravenously. On the seventh postoperative day the colostomy was perforated by cautery and the drain and three 2 inch iodoform gauze packs were removed from the perineal wound. A small amount of seropurulent fluid escaped with the gauze but this was apparently sterile

pus. Four cubic centimeters of 5 per cent mercurochrome were injected into the cavity, which promptly closed. The patient left the

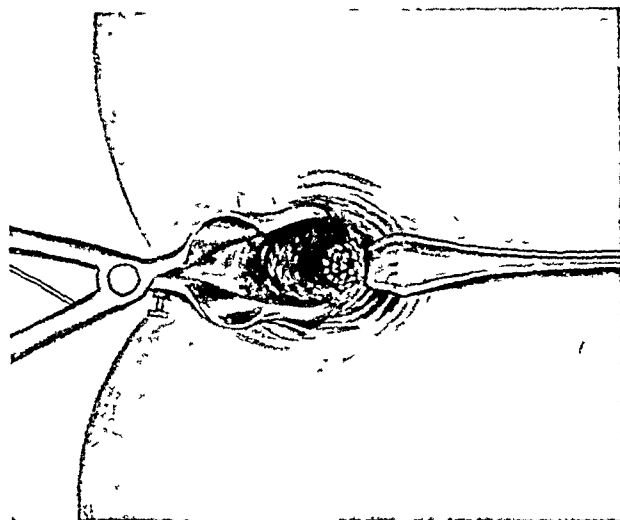


FIG. 1. Adenomatous polyp on posterior wall of rectum. Base of polyp becomes carcinomatous in 50 to 60 per cent of all cases.

hospital with the wounds healed by primary intention and the colostomy acting nicely on October 31, 1929.

Benign tumors of the intestine are infrequent; but of all benign tumors, the adenomatous polyp is the most common. They occur usually in males of younger age and less often in women.

The etiology of these polyps is not clearly understood, though infectious or irritable colitis and long-standing constipation are considered causative. This patient had none of these predisposing factors.

The most important pathologic feature is that 50 to 60 per cent of these tumors become carcinomatous. They are usually situated in the large bowel but may occur in the small intestine. They are usually multiple but may occur singly as in this instance. Those adenomas located in the rectum are more likely to become malignant.

\* Submitted for publication November 1, 1929.

The symptoms are not often striking. Bleeding from the rectum, as a solitary evidence of disease, is worthy of careful study of the entire intestinal tract. Occasionally slight indigestion, diarrhea, obstipation or even obstruction may occur.

The diagnosis is made only upon careful investigation of the alimentary tract when any of these symptoms cause the patient to seek advice. They may be mistaken for fibromas or myomas which come from different layers of the bowel; for hemangiomas which are extremely rare, and present the characteristic appearance of hemangiomas elsewhere. Lipomas also may be confused, though they originate from the fatty protrusions higher in the intestine and their appearance in the rectum would be unusual to say the least. The differentiation from malignancy is impossible without microscopic study. When the lesion is in the rectum and plainly visible, opinion may be erroneous. Where a large number of tumors is present, as in polyposis adenomatosis

intestinalis, the findings are usually benign, but even this picture may be carcinomatous. If a rectal polyp be examined and found benign, it may be assumed that the remainder of the nodes are benign.

The treatment of the condition will vary, of course, with the placement of the neoplasm. In any case, careful preoperative and postoperative attention, as already mentioned, is needed. The entire growth must be removed and especial effort made, if carcinomatous degeneration has commenced, to excise all the disease. With the bowel filled with polyps, ileostomy is done as performed by Lilienthal and Lockart Mummery; and a year later, the entire colon is resected. It seems that the resting of the colon may prevent formation of carcinoma. In the case cited, we were fortunate in finding a very early carcinomatous lesion and in being able to remove the diseased area entirely, with prompt convalescence. It may be hoped that the cure will be permanent.



## FIBROADENOMA IN AN ACCESSORY BREAST\*

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DELAFIELD and Prudden say:

Supernumerary mammary glands, polymastia, at one time considered comparatively rare are now known to be frequent; and the literature abounds with references to their occurrence in both sexes and on almost every portion of the body. In many cases these supernumerary glands are inactive but in females they may become functionally active at each pregnancy and differ in no way from the normally situated glands: in the male also these glands may secrete milk. *Adenoma or carcinoma may develop in them.*

Anyone who is aware of the condition has seen numerous examples of accessory breasts, mostly vestigial, represented by a rudimentary nipple, but this case is the

first I have seen of a tumor growing in the accessory breast.

Mrs. L. D., a young white woman, twenty-three years old, married, had had no pregnancies and had been thought by one doctor to have tuberculosis but this had been disputed by other very competent physicians. Two years previously she had been told by her family physician that two small brown spots below her breasts were accessory mammary glands. About two years ago she noticed a slight swelling in the region of the left accessory nipple and this had slowly but steadily increased in size until it had formed a considerable lump and was uncomfortable most of the time and quite painful when she was menstruating. She wanted it removed because it was uncomfortable and she feared cancer.

\* Submitted for publication August 13, 1929.

Examination showed a pale, thin, flat-chested young woman with two normally developed breasts. About 3 in. below their lower borders in the nipple line were two rudimentary, small, brown, slightly elevated areas with a few hairs growing around them, obviously accessory nipples. Beneath the left one and extending below and to the outer side of it was a smooth mass shaped like half an egg cut longitudinally and firm and elastic to the touch. The skin over it was freely movable and it moved freely on the chest wall. It was slightly sensitive to pressure. There were no palpable glands in the axilla. No mass was palpable beneath the right accessory nipple.

The skin and subcutaneous tissue were infiltrated with procaine hydrochloride and a transverse linear incision was made with a small ellipse in its center, around the accessory nipple. The tumor was completely encapsulated and was shelled out very easily with practically no bleeding. The other accessory

nipple was excised and the incisions closed with a rubber dam drain to the tumor cavity for forty-eight hours. Both healed by primary union except that a little serum came from the drainage tract for five or six days. The tumor removed measured  $6 \times 4 \times 3$  cm. and was slightly nodular on its superficial surface while its deep surface was slightly concave and fitted accurately the contour of the chest wall. There was everywhere a distinct capsule. It had a firm elastic feel. On section it was grayish white and very cellular in appearance. Microscopic sections showed an abundant fibrous stroma containing many glandular structures mostly small and of rather uniform size but some of them larger and of a less regular contour. They were for the most part lined with a single layer of cuboidal cells with a definite basement membrane everywhere and nowhere were there more than two or three layers of cells, a typical fibroadenoma as we see them in the fully developed breast.



## SIMPLE LATERAL LUXATION OF THE ATLAS\*

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NEW YORK

IN 1907, Corner<sup>1</sup> drew attention to the frequency of simple rotary dislocation of the atlas. Although the diagnosis is relatively simple when thought of, most of the reported cases have only been diagnosed at the autopsy table. Scattered communications stress the clinical features and describe the difficulties of radiological diagnosis. Jackson,<sup>2</sup> in 1927, was able to collect 27 simple cases in a wide study of the literature. He had seen 4 cases, in none of which the diagnosis had been made by the physician in charge. Simple lateral luxation of the atlas has not yet, as far as we could learn, been described.

This report is made in view of the apparent infrequency and yet claimed frequency

of simple atlas dislocations; and the interesting diagnostic problem and radiological findings that were present.

CASE 1. R. M., aged thirty-five, was admitted to the hospital on May 21, 1929. Her chief complaint was inability to use the left arm and leg. The past history was negative except for rheumatic fever at the age of twenty. The present illness began six weeks before admission with a recurrence of rheumatic joint involvement. Two days before admission the patient felt faint, lost consciousness and fell across the bed. On admission the physical examination showed a well-nourished adult female, distinctly stuporous. Questions put to her received only vague mumbled responses. The skin was generally moist, that of the face both moist and greasy. There was a left hemiplegia with supranuclear facial paresis, absent left abdominal reflexes and a bilateral Babinski sign, more marked on the left. At

<sup>1</sup> Corner, E. M. Rotary dislocations of the atlas. *Ann. Surg.*, 45: 9, 1907.

<sup>2</sup> Jackson, R. H. Simple uncomplicated rotary dislocation of atlas. *Surg., Gynec. & Obst.*, 45: 156, 1927.

\* From the Fourth Medical Division and Department of Radiology, Bellevue Hospital, N. Y. Thanks are due Dr. Alexander Lambert for permission to make this report. Submitted for publication August 20, 1929.

the apex of the heart there was a presystolic and systolic murmur with systolic shock; at the base, accentuation of the pulmonary

was  $\frac{3}{8}$  inch. A tender mass was noted at the angle of the right mandible. Diagnosis: Adenitis with secondary trismus.



FIG. 1 A Upper cervical vertebrae in normal position. B. Rotary luxation of atlas. C. Lateral luxation of atlas.

second sound. There were occasional extrasystoles. Spinal puncture showed a blood-tinged fluid under slightly increased pressure. Diagnosis: Subacute bacterial endocarditis with cerebral embolus.

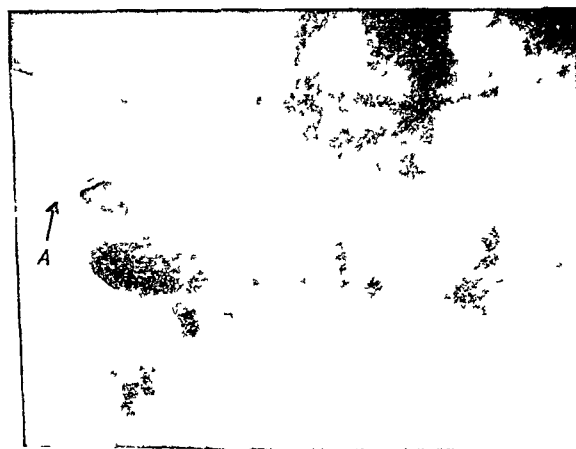


FIG. 2. Upper cervical vertebra of case reported. A, transverse process which was palpable, as described in text.

On May 27 the patient was more bright and it was noted that she held her head in a peculiar position. The face was turned moderately to the left, but somewhat awry so that the axes of head and trunk formed an obtuse angle to the right. The normal position of the head could apparently be actively restored by the examiner but it would soon resume the abnormal one. In these maneuvers the head was rotating on the lower cervical vertebrae. The mouth could hardly be opened. At most, the distance between upper and lower teeth

The condition persisted; the patient could not be fed adequately. A more careful examination now showed that the supposed gland was bone, and probably the transverse process of the atlas. On the left side, a depression was felt behind the angle of the mandible. Normally the transverse processes may be felt deep and high between the angle of the mandible and the mastoid process. Posteriorly the spine of the atlas was palpated somewhat to the right of the mid line. Neither at this time nor any subsequent time were cord, root, or nerve involvements present.

Clinical Diagnosis: Rotary dislocation of the atlas.

Roentgen-ray Diagnosis: Lateral luxation of the atlas.

The literature and radiological evidences of this condition were now investigated. It was impossible to correct the dislocation due to the seriousness of the patient's condition. The temperature fluctuated between  $101^{\circ}$  and  $103^{\circ}\text{F.}$ ; decline was gradual, and the patient died on June 18. No autopsy was obtained.

#### CLINICAL FEATURES

Rotary dislocation of the atlas is usually unaccompanied by cord or root involvement. The condition may be chronic for years in ambulant patients. The primary injury may be trivial. The degree of dislocation varies in different patients. The case reported clinically gives features identical with those described in rotary disloca-

tion of the atlas. It is unusual in that it occurred in a fall due to a cerebral accident in the course of subacute bacterial endocarditis. It showed the cardinal features of simple rotary dislocation and lateral luxation; deviation of the head, trismus, and palpable displacement of the transverse and spinous processes of the atlas. It was impossible to examine the atlas by oral palpation due to the extreme trismus. It is possible that if more frequently considered, the condition would be more frequently diagnosed. It is also possible that certain cases previously described as rotary dislocation really were lateral luxation.

#### RADIOLOGICAL FINDINGS

While there is no doubt that luxation of the atlas can be diagnosed clinically, the differentiation between the simple lateral and rotary lateral can be made only radiographically. The former condition when present is more difficult to recognize in view of the slight abnormal findings. The rotary lateral luxation produces so much

distortion that its presence is readily recognized on the radiograph. This can be seen on the accompanying photographs of experimentally produced luxation of a dried specimen of vertebrae.

The cardinal signs in lateral luxation of the atlas are: (a) the obliteration of the transverse process on one side; (b) the malalignment of the articulating surfaces of the atlas and axis; (c) eccentric situation of the odontoid process.

These findings can be seen only in the anteroposterior position. The lateral view of the cervical spine does not show any abnormality.

#### SUMMARY

Simple lateral luxation of the atlas, a case of which is here reported, has to our knowledge not yet been described. Simple dislocations of the atlas are said to be more frequent than generally believed. The recognition of this condition is not difficult when considered in the differential diagnosis both clinically and roentgenologically.



## OSGOOD-SCHLATTER'S DISEASE\*

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SINCE Osgood described this condition of the tibial tubercle,<sup>1</sup> different writers have written of it and reported cases. As it is of more common occurrence than is generally supposed and is frequently overlooked by the busy practitioner, I am taking the liberty of citing the following cases, which have come under my observation recently. In all these cases the patients were young and active in school sports and attribute the condition to violent exercises. There was a history of pain during or following the engagement in some strenuous exercise. In Osgood's original article

he drew attention to the fact that generally the tubercle of the tibia is developed from the upper epiphysis of the tibia and comes down in a beak-like projection which begins to unite to the shaft about the age of puberty. In rare cases the tubercle is developed in a separate center. To the tip of the tongue-like projection the fibers of the patella ligament are attached and during violent exertion it is quite easy for a portion of the bone to be torn away.

CASE 1. F. T., aged fifteen years, was seen by me on May 7, 1927, with a history of pain over the tubercle of the tibia, of four months' duration. It was first noticed while wrestling

<sup>1</sup> *Bost. M. & S. J.*, 1903.

\*Submitted for publication September 19, 1929.





FIG. 1. Appearance of normal tubercle of tibia of boy aged fifteen years.



FIG. 2. Case 1. Left knee. Note irregular appearance of tubercle with tearing-away of small portion.



FIG. 3. Case 1. Three months later. Note bone proliferation.

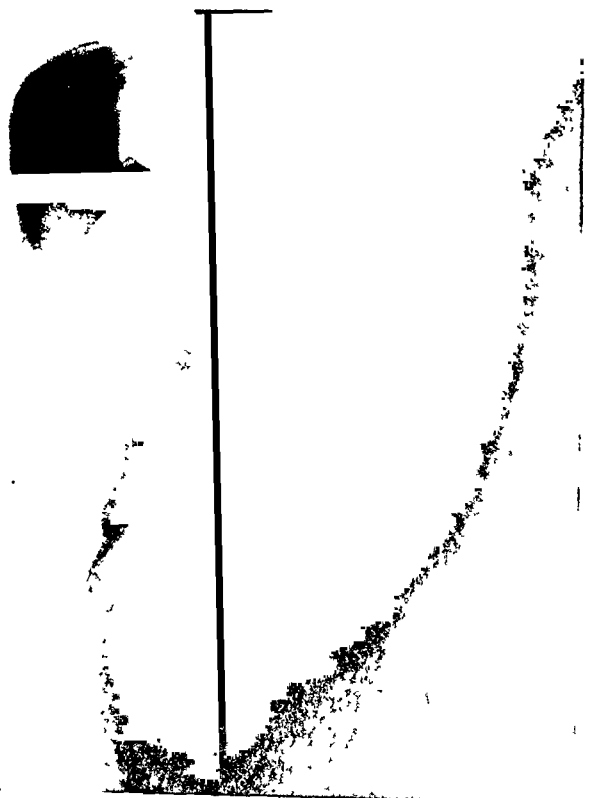


FIG. 4. Case II. Left knee. Tubercle attenuated with few fibers pulled away.

with another boy at school and gave considerable pain, which was relieved somewhat by rest. Pain remained and was especially noticed in going up and down stairs. On examination the tibial tubercle was found tender and swollen and there was some pain on flexion but less on extension. A roentgenogram taken at that time showed the peculiar thinning-out of the tubercle of the tibia with a moth-eaten appearance, quite different from the normal beak-like projection, as seen on the opposite tibia. The treatment was immobilization in a plaster cast, from midcalf to midthigh, first placing a piece of split felt over the tubercle and fixing with adhesive, then protecting the limb with cotton. This dressing was applied with the knee extended and caused little if any inconvenience, allowing the patient to walk on it and attend school duties. Cast was left on one month, then removed and reapplied. Patient stated that the pain disappeared immediately following the application of the cast. The second cast was allowed to remain on for five weeks and then removed. Following this the patient wore a bandage during the day only and the pain never reappeared. Three months from the time the first roentgenogram was taken, a second one was made, showing the thickening of the tubercle by bone callus. At this time there was no pain on pressure and no symptoms were elicited by extreme flexion or extension.

CASE II. W. B., aged fourteen years, was first seen on October 29, 1927 with a history of injury during a basketball game, three weeks before. The typical symptoms of pain on pressure and on going up and down stairs were complained of and the roentgenogram showed the same thinning-out, irregular appearance as shown in Case I. The treatment was identical and roentgenograms taken three months later showed a much different appearance than on the first examination. Here too we find much bone callus thrown out and the tubercle was not tender on pressure. The patient was symptom-free and discharged.

CASE III. A girl, aged fourteen years, hurt her knee in a gymnasium and gave the classical symptoms. Examination showed the same tenderness on pressure over the tubercle, which seemed swollen and there was pain on flexion and extension. Roentgenograms revealed the same appearance as seen in the former cases. Treatment instituted was immobilization in

plaster, changing the plaster at the end of five weeks. The patient then wore a bandage for five weeks after removal of the second cast.

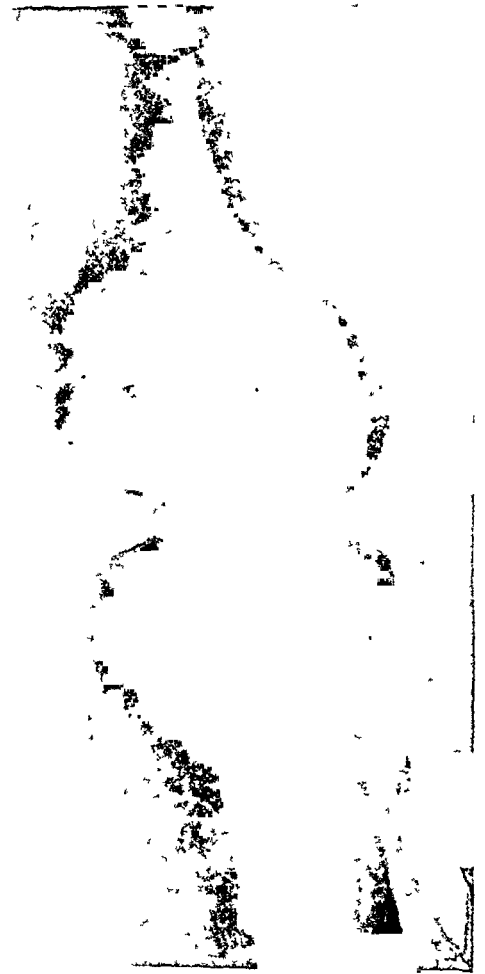


FIG. 5. Case II. Note thinning out of tubercle.

A final roentgenogram shows the same bone formation as seen in the other two cases. Patient was discharged at the end of three months, symptom-free.

I have kept in touch with these cases since discharge and there has been no return of symptoms.

#### CONCLUSIONS

1. A tearing-away of part of the tubercle of tibia may occur with only a moderate amount of disability.
2. The accident is most likely to happen from the ages of twelve to sixteen and more especially in strong athletic types.
3. Immobilization in plaster cast for from two to three months will allow nature to heal the lesion.

# VESICAL NECK OBSTRUCTION WITH LARGE VESICAL CALCULUS. BILATERAL HYDROURETERS

WITH HYDRONEPHROSIS. DOUBLE LEFT KIDNEY AND URETER\*

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NEW YORK

THE subject of this communication, (B. B.), is a young, poorly nourished man, 25 years of age, who was admitted



FIG. 1. Roentgenogram showing shadow of large calculus.

to the Urological service of the New York Post Graduate Hospital in July, 1928. The patient's complaint was painful micturition, which symptom had been constant for a period of 5 years. This pain was continuous throughout the act, and was particularly severe at the termination of the flow. No urethral discharge nor hematuria had been observed, but the stream was markedly diminished both in size and force. The patient voided about four times during the day, and there was frequency of four or five times at night.

Previous history revealed no evidence of venereal infection, as the patient denied both gonorrhea and genital ulcer of any kind.

Family history bore no relation to his present illness.

*Physical Examination.* A young man, some-

what emaciated, of rather sallow complexion and very anxious mien, who evidently had lost considerable weight. Eye examination is negative. Nose and throat reveal an atrophic rhinitis on the right side, with muco-pus in small amounts exuding from left turbinate bone. Uvula was markedly elongated and reddened, while the tonsils were deeply imbedded and congested, and a moderate amount of purulent material was expressed therefrom. The pharynx was congested, and the epipharynx was dry with crust formation. Diagnosis of subacute tonsillitis and pharyngitis was made from the aforesaid findings, and local treatments were immediately instituted. Heart and lungs were essentially negative. Abdominal examination revealed two palpable and movable kidneys, which were moderately tender. Palpation of the suprapubic area elicited tenderness over the bladder on both moderate and deep pressure. Rectal examination was negative, as was the examination of both extremities. Reflexes were moderately exaggerated. Temperature was 100.8°, pulse 100 and respirations 20. Three days after admission, routine x-ray examination of the genito-urinary tract, showed marked bilateral nephroptosis, with the shadow of a large round calculus in the bladder. (Fig. 1.)

Cystoscopic examination was performed under caudal anaesthesia, due to spasm at the internal sphincter and vesical intolerance. On introducing the cysto-urethroscope, its tip had to be elevated to override an obstruction, which, however, was overcome without difficulty. The bladder was of fair capacity, from which cloudy and purulent urine was obtained. The mucous membrane was inflamed throughout its entire extent. Two orifices of diverticula were observed mesial to the right ureteral opening. A large, rounded, movable calculus was seen, which obscured the interureteric ligament and the orifices of several diverticula. These were later demonstrated by a cystogram. The ureteral openings were normally placed, and both were visibly function-

\* From the Department of Urology, New York Post Graduate Medical School and Hospital. Submitted for publication February 8, 1930.

ing. However, upon the administration of Indigo Carmine, intravenously, no dye appeared during the entire period of the examination, which was over fifteen minutes. On the right side of the internal sphincter considerable tessellated edema was observed. The sphincter itself, was somewhat rigid, the floor raised, but its elevation above the interureteric ligament could not be estimated, due to the calculus; the post-montan area (waterfall) showed a sharp descent to the verumontanum.

**Diagnosis.**—Vesical calculus; vesical diverticula and trabeculae with chronic cystitis; bilateral pyelonephritis; probable median prostatic bar.

**Blood count:**

Red cells	3,800,000
White cells	10,600
Polynuclears	74 per cent

**Differential count of 100 cells:**

Polynuclear neutrophiles	73 per cent
Polynuclear eosinophiles	1 per cent
Transitionals	2 per cent
Small lymphocytes	17 per cent
Large lymphocytes	7 per cent

**Blood Chemistry:**

Uric acid	3.5 mgm. per 100 cc.
Urea nitrogen.	16.3 mgm. per 100 cc.
Sugar.	0.78 per cent
CO <sub>2</sub> combining power,	not determined.

While it was realized that the large vesical calculus was the result of the other pathologic conditions in the genito-urinary tract, it was deemed advisable to remove this calculus first, and put the bladder to rest by proper drainage. Accordingly, five days after admission, suprapubic cystotomy was performed, and a large calculus, the size and shape of a golf ball, was removed. (Fig. 2.) Convalescence was slow, and the wound drained urine for a considerable time. Catheter drainage was employed two weeks after operation, and it was observed that when the catheter was removed, the patient would complain of considerable pain in the right flank, and this was accompanied by a rise of temperature to 104°, with acceleration of pulse rate to 120. Re-introduction of the indwelling catheter was accompanied by cessation of pain, and diminution in temperature and pulse rate. Four weeks after operation, cystoscopy showed the bladder of fair capacity, with the trabeculae and diverticula as previously described, also the internal sphincteric condition as observed before, but more clearly delineated. Upon sealing the suprapubic open-

ing, a cystogram was made with 6 per cent sodium iodide solution. This showed a contracted bladder with multiple diverticula and

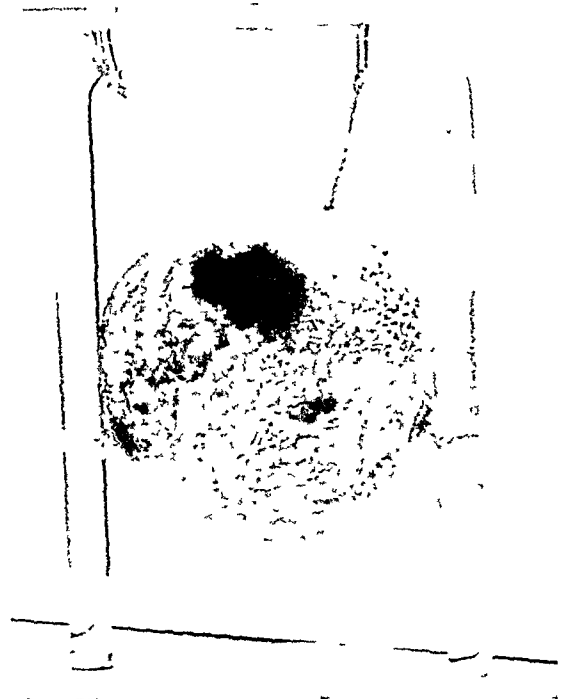


FIG. 2. Calculus removed from bladder.

trabeculae, also marked dilatation and tortuosity of the left ureter, and a moderate reflux up the right side. Indigo Carmine did not appear from either ureter in fifteen minutes.

Because of the very evident renal damage, and because of the persistence of the suprapubic fistula, all due, apparently, to the visible vesical neck obstruction, it was deemed advisable to reopen the bladder, and remove that obstruction. Accordingly, at this time, under general anaesthesia, the bladder was reopened, and a small piece of tissue was excised from the floor of the internal sphincter.

The pathological report of this specimen is as follows: the epithelium is hyperplastic, with no visible glandular structure. The submucosa shows a rather thick layer of fibrous tissue which is rich in small and large blood vessels. The walls of the vessels which are nearer the mucosa seem to be thicker than those which are situated more deeply. The vessels nearer the mucosa are small capillaries, while rather thick-walled arteries are seen in the deeper tissue. There are one or two areas of round celled infiltration. In the depth of the specimen, there are hypertrophic muscular fibres, with a small amount of perivascular infiltration. (Fig. 3.)

The whole picture is that of:

- (a) Hypertrophic musculature.
- (b) Secondary submucosal chronic inflammation, which is superficial.



FIG. 3. Low power photomicrograph of tissue removed from internal sphincter.

- (c) Inflammation and fibrosis superimposed upon the congenitally hypertrophied sphincter; with most of the inflammation in the superficial areas.

*Pathological Diagnosis.* Fibrosis of bladder neck.

Because of secondary hemorrhage, it was necessary to reopen the wound twelve hours after this operation, and moderately pack the base of the bladder. Transfusion was given at this time, followed by intravenous infusions of glucose in saline solution, and on the day following this operation, another transfusion was administered. The patient's general condition was poor, the temperature ranging from  $101^{\circ}$  to  $103^{\circ}$ , with an occasional excursion above  $104^{\circ}$ , on one occasion to  $106^{\circ}$ . There was coincidental marked acceleration of the pulse rate.

Blood chemistry studies, instituted at this time, (Table 1), showed a very definite uremic

acidosis. This condition lasted for about two weeks, and was energetically treated by the administration of weak glucose solution, with bicarbonate of soda. Urine excretion was entirely suppressed on August 28th, and severe post-operative hemorrhage followed resection of a congenital band at the internal vesical sphincter. For this hemorrhage a transfusion of 500 cc. of blood was given on August 28th, followed by a transfusion of an equal volume the following morning. The anuria persisted during August 29th, when the blood urea nitrogen had risen to 27.4 and the uric acid to 6.0 mg. per 100 cc. A moderate acidosis was indicated by the carbon dioxide combining power of 33.8 volumes per cent. A mild hyperglycemia, (0.165 per cent) was also noted coincident with a temperature of  $105^{\circ}$ . This increased blood sugar is no doubt dependent upon the acute infection. An infusion of 1000 cc. of physiological salt solution containing 1 cc. of 1:1000 adrenalin solution preceded the introduction of the Levine duodenal tube. Magnesium sulphate was first administered through the tube, followed by 500 cc. of tap water, and 500 cc. of 5 per cent glucose solution containing 1 per cent sodium bicarbonate. The intraduodenal infusion of glucose and sodium bicarbonate was repeated four hours later. Blood urea nitrogen on August 30th, had risen to 43.8 mg., the uric acid to 7.4 mg. but the carbon dioxide combining power had been elevated to 38.1 volumes per cent. A small volume of bloody urine was obtained during this day, and another litre of glucose and sodium bicarbonate solution was administered through the duodenal tube. However, the blood urea nitrogen continued to rise, reaching its maximum at 62.5 mg. per 100 cc., on September 1st. A creatinine of 4.5 mg. per 100 cc. was obtained on August 31st, and uric acid of 7.2 mg. per 100 cc. The carbon-dioxide combining power of the blood of August 31st, was 43.8 volumes per cent. During the first twelve hours of August 31st, the volume of urine drained was too small for estimation, but for the latter twelve hours of the day 210 cc. of urine drained, which was the first measurable quantity of urine excreted during a period of 72 hours. The total intake of fluid for August 31st, was 4,000 cc. Frequent liquid stools were passed during the 72 hours of urine suppression, and we believe the excretion of an abnormal amount of fluid by the intestinal tract served to diminish the accumulation of nitrogenous waste products in the blood. Moreover, the use of physiological

salt solution in hypodermoclysis and intravenous infusions maintained the blood chlorides within normal limits despite the loss of chlorine

erated production of creatinine from creatine consequent with the increase in body temperature causes the persistence of a high blood



FIG. 4. Complete urographic study, resulting from vesico-renal reflux of 6 per cent sodium iodide solution. This picture was made prior to complete removal of obstruction at internal vesical sphincter.



FIG. 5. Urographic study with 6 per cent sodium iodide solution revealed no vesico-renal reflux, 1½ years after removal of obstruction at internal vesical sphincter.

in the vomitus, and thus obviated the production of an alkalosis. The patient's general condition on September 2d, indicated definite clinical improvement, the volume of urine rising to 2,100 cc. Thence, the duodenal tube was removed, and thereafter fluids were given by mouth, supplemented by hypodermoclysis of 5 per cent glucose in physiological salt solution. On September 4th, the blood creatinine rose to 8.9 mg. per 100 cc. although the urea nitrogen had shown a steady decrease from 62.5 to 54.8 during the preceding 48 hours. However, six days later the creatinine had fallen to 5.3 mg., with urea nitrogen of 56.6 mg. per 100 cc. A continuous decline in urea nitrogen of the blood to 16.0 was noted for the subsequent 8 days, but the creatinine remained above normal, fluctuating from 5.3 to 3.7 mg. per 100 cc. During the period from September 2d until September 26, the body temperature varied from 101° to 105°, and the peaks in the temperature curve were followed by chills. An accel-

erated production of creatinine from creatine consequent with the increase in body temperature causes the persistence of a high blood creatinine. A periurethral abscess was incised and drained through the perineum on September 18th, and a few days later a lumbar abscess was incised, the culture of contents showing paracolon bacilli and non-hemolytic streptococci. Blood culture, however, gave no bacterial growth. Thereafter the temperature ranged from 99° to 100°. For a period of 72 hours, from September 21st to 24th, during an attack of acute pyelitis of left kidney the volume of urine voided fell to 300–500 cc., and this oliguria was accompanied by an increase in urea nitrogen of the blood until September 26th. From the time of the cystotomy until October 22d, the urine was drained through a Ritter tube in the suprapubic wound. On October 22d, the Ritter tube was removed, and thereafter the urine was voided per urethram. The volume of urine excreted daily after September 26th approximated the total fluid intake. Chemical blood analyses made at intervals of from 4 to 7 days from September 26th

until November 9th gave normal figures for urea nitrogen, creatinine, sugar and carbon dioxide combining power of the plasma. However, the renal function was still definitely impaired. For several months attempts to estimate renal function by colorimetric methods revealed amounts too small for measurement. The hyperchloremia noted in the last of these specimens was due to a decrease in erythrocyte volume, associated with a moderate secondary anemia. After October 1st, the patient was on a high caloric diet, and spent the greater part of the day out of bed on the roof.\*

TABLE I  
CHEMICAL BLOOD REPORTS

Date	Urea Nitrogen	Uric Acid	Sugar	Chlorides	CO <sub>2</sub>	Creatinine
7/10/28	16.3	3.5	0.018			
8/29/28	27.4	6.0	0.165	0.478	33.8	
8/30/28	43.8	7.4	0.103	0.462	38.1	
8/31/28	61.0	7.2	0.105	0.495	43.8	4.5
9/1/28	62.5	...	...	...	39	
9/4/28	54.8	...	...	...	47.5	8.1
9/10/28	56.6	6.1	0.102	...	44.7	5.3
9/12/28	36.0	...	...	...	50.4	
9/18/28	16.1	3.7	0.091	...	57.9	
9/21/28	26.8	5.6	0.098	...	...	3.7
9/24/28	37.4	...	0.086	0.544	57.9	
9/26/28	23.2	4.5	0.089	...	...	
9/28/28	19.1	...	0.094	...	...	
10/1/28	15.	3.9	...	...	59.8	
10/3/28	13.1	4.1	0.086	...	55.1	
1/18/29	12.6	...	...	...	50.4	

X-ray studies on frequent occasions by means of cystography always showed marked vesico-renal reflux on each side, with clear delineation of the bladder, ureters and kidneys; with a very evidently contracted bladder, showing multiple diverticula and trabeculae; and with marked bilateral ureteral and renal pelvic dilatation and left ureteral and renal duplication. (Fig. 4.) This patient's convalescence was very slow and most gradual, and the suprapubic sinus persisted for months. In November, 1928, four months after admission to the hospital, cystoscopic punch procedure was performed, which removed the remaining portion of the median bar. So thoroughly was this done, that within two weeks after this operation the

suprapubic wound was closed. While the wound reopened on two occasions within the next month, it has remained permanently closed for the past year. After five months of hospitalization, this patient was discharged from the hospital, although he had very definite evidence of moderate pyonephrosis of the double left kidney, and pyelonephritis of the right kidney. He has continued to improve most remarkably and has gained over fifteen pounds in weight in the past six months. During this time he has followed a most arduous occupation in an airplane factory, and has not been called upon to give up his occupation at any time because of any physical infirmity. One month after leaving the hospital, urea nitrogen and CO<sub>2</sub> combining power determinations were well within normal limits. For the first time in six months, phenolsulphonaphthalein appeared in about 17 per cent in two hours.

P.S.P. test made on January 31st, 1929, was as follows:

Spec. 1st half hour Vol. 15 cc. P.S.P. trace  
Spec. 2d half hour Vol. 125 cc. P.S.P. 8.9 per cent  
Spec. 3d half hour Vol. 65 cc. P.S.P. 5.11 per cent  
Spec. 4th half hour Vol. 48 cc. P.S.P. 3.9 per cent

Our patient has been observed at occasional but regular intervals since he left the hospital, and a marked decrease in the frequency of micturition has been noticed. Cystoscopic examination reveals very little vesical change, although there is no obstruction of any kind at the internal sphincter or on the floor of the prostatic urethra. Urine examination shows a faint trace of albumin, with fifteen to twenty pus cells per high power field. Within the past two weeks, blood chemical study showed a return to within normal limits, and the phenolsulphonaphthalein output was 47.1 per cent in two hours, consisting of 13.4 per cent in the first hour and 33.7 per cent during the second hour. Upon the day of this test, a cystogram with 6 per cent sodium iodide solution was made, which revealed no evidence of vesico-urethral obstruction; a somewhat larger bladder capacity than heretofore, with no vesico-renal reflux, although there is some evidence of ureteral dilatation for a short distance on each side. (Fig. 5.)

#### CONCLUSIONS

(1) A patient is presented with very definite evidence of vesical neck obstruction, giving rise to vesical and renal pathol-

\* We desire to express our thanks to Professor John A. Killian of the Department of Biochemistry, for the above blood chemistry studies and their interpretation.

ogy in the presence of a left ureteral and renal anomaly.

(2) Marked renal insufficiency with definite surgical pathology has been completely relieved by removal of the vesical neck pathology.

(3) Essential surgery was followed by prolonged convalescence with subsequent complete improvement of the patient.

#### DISCUSSION

DR. JOSEPH A. HYAMS. From the history, associated congenital abnormalities of the urinary tract, and cysto-urethroscopic examination, the obstruction at the vesical neck could be classed as congenital in origin. The microscopic examination confirmed the clinical observation and showed an hypertrophic musculature with secondary submucosal chronic inflammation superficial to it. There was inflammation and fibrosis superimposed on the congenital hypertrophy of the sphincter with most of the inflammation superficial, with a gradual decrease toward the deeper structures. The vessels near the mucosa were small capillaries with rather thick walled arteries in the deeper tissues, conforming to the congenital type of sclerosis described by Herbst and others. Herbst, however, believes that this type of congenital muscular hypertrophy is the cause of all cases of fibrosis of the vesical neck, wherein an hypertrophied sphincter muscle, due to continuous congestion and inflammation, later becomes fibrosed. This has not been verified by our examination of ten specimens removed from known cases of median

bar and coarctation of the vesical neck. Inflammatory fibrosis has been found to be a far more frequent cause for this condition.

A possible explanation for the bleeding which occurred after the suprapubic removal of the wedge shaped piece of tissue, is found in the large number of good sized vessels seen in the base of the microscopic section of the excised tissue.

The co-existence of median bar and vesical calculus is not unusual. Young, in a study of 209 cases of median bar, found calculus present in 20 per cent, whereas diverticulum of the bladder was observed in 30 per cent. The latter is conceded to be a very frequent associated abnormality.

An important element in the prognosis of vesical calculus is the co-existence of median bar or congenital pathology which may be present and is not noted unless no detail of history and physical examination is omitted, and a complete urological examination is carried out.

In a case reported by Mathé, the procedure followed in our patient was unfortunately reversed. The patient, 41 years of age, was compelled to begin catheter life at 21 years of age; no relief was obtained by cystotomy, and a later perineal exploration of the prostate, and at a still later date, nephrectomy. Finally a v shaped trough was made in the median bar, and his symptoms were relieved.

In our case, the kidneys may be said to be in a state of renal compensation. With congenital and acquired pathology, and infection still present in the urinary tract, any disturbance of this delicate balance is to be expected at any time.





# HEADACHE (POST-TRAUMATIC)

## RELIEVED BY LUMBAR AIR INSUFFLATION REPORT OF A CASE\*

H. L. SKINNER, M.D.

SAVANNAH, GA.

POST-TRAUMATIC headaches when not secondary to fracture are usually diagnosed as meningeal headaches, traumatic neurosis, or malingering, according to the severity of the injury and symptoms. All who have done any accident or industrial surgery have been in doubt how to classify this type of case and have found the relief of the symptoms difficult.

During encephalographic studies different observers have noted that some patients with chronic headache were relieved, but it was not until Penfield<sup>1</sup> reported the use of lumbar air insufflation for the treatment of headache, that this method was clearly described as a therapeutic procedure.

The following case is reported for the purpose of again inviting attention to the satisfactory results obtainable by this method in otherwise intractable cases.

J. G., colored male, aged forty-two, occupation carpenter, admitted to U. S. Marine Hospital, Savannah, Georgia, October 24, 1928 for examination to determine right to compensation under National Employees' Compensation Act.

*History.* In February 1924, while employed, was struck on the vault of the skull, left frontoparietal region, by a heavy timber. There was no bleeding from the nose, mouth or ears, and examination at this hospital the following day showed no evidence of fracture of skull. At that time vision was normal, eye grounds were normal, hearing was normal, and there was no evidence of damage to the middle ears. Later examination showed that he had albumin and casts in the urine; that there was thickening of the superficial vessels with blood pressure of 144 systolic and 108

<sup>1</sup> Penfield, W. Chronic meningeal (post-traumatic) headache and its specific treatment by lumbar air insufflation; encephalography, *Surg., Gynec. & Obst.*, 45: 747, 1927.

diastolic; and that the Wassermann reaction was plus 3. Since the injury he has been unable to work on account of continuous pain in left side of head. The pain has been dull in character with occasional sharp darting pains, and has been increased by movements, especially stooping.

The patient has been under observation here and occasionally hospitalized ever since the injury. Treatment has been antisyphilitic and directed toward relief of the symptoms of nephritis and arteriosclerosis.

*Chief complaint* on admission was continuous headache and dizziness.

*Physical examination* on admission shows a fairly well developed, slender man, weight 145 lbs., height 5 ft. 11 in. Head is normal in contour and without scars, tenderness, or evidence of injury. The hearing in the left ear is somewhat impaired. Pupils are equal and small, reacting to light and accommodation. Vision 20/70, each eye unimproved by lenses. Eye grounds show optic atrophy bilateral and arcus senilis is present. There is no evidence of paralysis of the face or deviation of the tongue. The deep and superficial reflexes are normal. The only other positive finding is thickening of radial and brachial vessel walls.

*Laboratory findings* are: Urinalysis negative; feces negative. Wassermann reaction 3 plus on one occasion and negative on two occasions. Spinal fluid: Wassermann reaction negative; cell count normal; globulin negative, and no mastic curve.

X-ray of the skull showed a slight depression of the vertex at the junction of the frontal and parietal bones which may possibly be due to an old fracture. This depression disturbed the continuity of the inner table. There was no other deformity present.

In comparing the findings in this case with those reported in the literature, we concluded that the patient might be susceptible to relief by air insufflation which was undertaken on November 23, 1928.

The procedure was carried out under aseptic

\* Submitted for publication August 1, 1929.

conditions in the operating room, the patient being given  $\frac{1}{4}$  grain of morphine before leaving the ward. He was placed on his right side with head elevated about  $30^{\circ}$  and brow pointing upward. The spinal fluid pressure was 14 mm. Hg. The fluid was withdrawn in 5 c.c. amounts, 5 c.c. of air which was filtered through cotton being injected after each withdrawal. Before starting, we made sure that all connections were air tight and syringe tight-fitting. Eighty cubic centimeters of fluid were removed and replaced with 70 c.c. of air. During the procedure patient complained of severe pain in left side of head.

Without changing his position, he was sent to the x-ray room and the usual skull pictures taken. On changing position of head, patient became very nauseated and pain more severe.

After x-ray plates were taken, he was placed in bed with low blocks under head of bed. He was directed to lie on right side in order to keep left side of head uppermost, that side being the one where the headaches were more severe and constant. For five days patient complained of headache in left temporal region and top of head, describing it as dull in character except when moving head, at which time it became sharp and shooting in character. He was kept in bed until headache disappeared. The x-ray showed air scattered throughout the subarachnoid space, especially the left side, and no cyst formation was seen. He was discharged free from headache and dizziness on December 11, 1928. Five months later he was seen, and had suffered no recurrence of headache or dizziness.



# DEPARTMENT OF RADIOLOGY

JAMES T. CASE, M.D., F.A.C.S., EDITOR

## FUNDAMENTALS IN ROENTGENOLOGY OF THE COLON\*

JAMES T. CASE, M.D., F.A.C.S., D.M.R.E.

CHICAGO, ILL.

THE roentgen-ray study of the colon is one of the most interesting investigations in the field of diagnosis, but its success is in a high degree dependent upon the skill and experience of the individual radiologist. The roentgen findings are susceptible of so many plausible but erroneous interpretations that it behooves one to become as familiar as possible with the physiological variations of the normal colon, especially relating to its motor behavior, in order to interpret properly the findings in a given case. There are very many variations of the normal and a great many pathological conditions which simulate various phases of the normal.

### TERMINOLOGY

For convenience, as well as for anatomical reasons, it is proper to divide the large intestine (Fig. 1) into: (a) the cecum, that portion of the large bowel proximal to the ileocolic junction; (b) the ascending colon, from the ileocolic junction to the hepatic flexure; (c) the transverse colon, from the hepatic flexure to the splenic flexure; (d) the descending colon, from the splenic flexure to the level of the crest of the left ilium; (e) the iliac colon, from the left iliac crest to the iliopectineal line; (f) the pelvic colon, from the iliopectineal line to the rectal ampulla opposite the third sacral segment. The junction between the iliac and the pelvic colon may be termed the ilio pelvic junction, and that between the pelvic colon and the rectum the pelves rectal junction. The term sigmoid, which includes both the iliac and the pelvic colon, does not find a place

in the more convenient terminology given above.

### ANATOMICAL CONSIDERATIONS

In its roentgenological aspects the large intestine is easily distinguishable from the small, both by its greater size and by the characteristic haustral sacculations which occur through the large bowel with the possible exception of the lower pelvic colon and rectum.

The colon represents about one-fifth of the whole extent of the intestinal canal, being on an average  $4\frac{1}{2}$  to 5 ft. in length. Extremes have been recorded from 3 ft. to more than 6 ft. The caliber of the colon varies considerably according to whether it is visualized by an opaque enema or by ingested opaque material. After the injection of 1200 c.c. of opaque enema, the following may be considered as the average diameters of the normal colon on a roentgenogram made at a focus-skin distance of 65 cm., the patient lying prone upon the film: cecum 6.0 c.; ascending colon 5.0 cm.; transverse colon 5.0 cm.; descending colon 4.5 cm.; iliac colon 4.0 cm.; pelvic colon 3.5 cm. These figures were arrived at after measurement of a series of normal colons.

### OPAQUE MEAL OR OPAQUE CLYSMA IN STUDYING THE COLON

Following an opaque meal, the measurements of the colon vary considerably from the foregoing estimates, and yet one must admit that the exact caliber of the lumen of the bowel as it ordinarily exists is much more faithfully recorded after an opaque

\* Received for publication March 20, 1930.

[This is the first of a series of papers by Dr. Case on the Roentgenology of the Colon. The next will appear in an early issue.]

meal than after a barium enema. In fact, for the study of the colon it appears to the writer that one should employ both

The enema may cause a totally abnormal filling, and in nervous individuals it may produce exaggerated intestinal tonicity

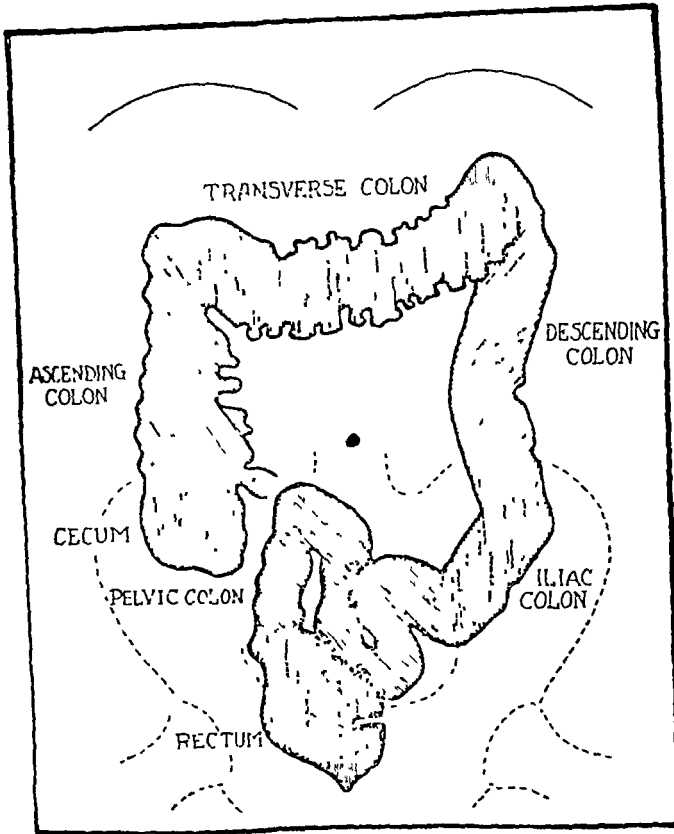


FIG. 1 Illustrating the divisions of the colon according to the newer terminology. Instead of *sigmoid*, we speak of the *iliac colon*, from the iliac crest to the iliopectineal line, and of the *pelvic colon*, from the iliopectineal line to the junction with the rectal ampulla opposite the third sacral segment.

the opaque meal and the barium clysma, especially if one is interested in a study of colonic function. It does not seem possible to arrive at worthwhile conclusions regarding the function of the colon from the opaque enema study alone. Both the meal and the enema are essential. It is hard to believe that there is any appreciable difference in the size, form and position of the colon under the supposed "weight" of an ordinary non-opaque meal and that of an ordinary meal into which has been stirred 2 to 4 c.c. of barium sulphate. On the other hand, how distorted the clysma-filled colon (Fig. 2) may be, is easily demonstrated by comparisons of a few roentgenograms of the clysma-filled and the meal-filled colon.



FIG. 2. Appearance of enema-filled colon, with marked distortion of the proximal colon due to overdistention.

to such a degree as to simulate spastic conditions or even organic constrictions. In fact, the opaque enema influences the colon in almost every respect in an entirely different manner from the opaque meal. With the former, haustral markings are nearly always absent; with the latter the haustral segmentation is always present except during the short period required for the execution of the spontaneous mass movements which constitute the principal propulsive activities of the colon. The position of the enema-filled colon is often abnormal, especially when the rectal injection has been made with the patient in the knee-chest position. The transverse colon, particularly, may be shortened and raised, presenting an appearance very different from that seen in the case of the functioning bowel. The knee-chest position for the introduction of the opaque injection is quite unnecessary, for unless there is some gross obstruction the colon fills easily when the patient lies supine. The use of the Trendelenburg position may lead to serious misapprehension as to the morphology of the colon.

## POSITION OF THE NORMAL COLON

The average colon in health (Fig. 3) may be described as follows: With the

crests, although in this same type of individual the transverse colon may lie well above the navel when the patient



FIG. 3 Appearance of average colon of normal individual, after careful filling by opaque enema, care being exercised not to overdistend. Compare with Fig. 3.

patient standing, the lower border of the cecum reaches as low as the right iliopectineal line, the hepatic flexure extends upward as far as the costal margin, and the splenic flexure reaches as high as the lower border of the spleen. The level reached by the lower border of the transverse colon varies considerably in different patients as well as at different times in the same patient.

The shape of the colon in average normal individuals varies considerably with the physical type: in short, stocky people tending to obesity (Fig. 4) the transverse colon, as well as the lower border of the stomach, is usually high, the lowest point of the transverse colon approaching a line joining the iliac crests; whereas in tall, slender individuals the transverse colon is likely to be v-shaped or u-shaped, its lower border normally reaching several inches below the line joining the iliac



FIG. 4. The enema-filled colon of an obese individual.

lies supine, or when the pelvic loop is well filled.

## MOBILITY OF THE COLON

The colon should be freely movable throughout at all points which can be reached by the examining finger (of course, with the protection of a leaded glove) palpating under the guidance of the fluoroscopic screen. It should be possible to move the tip of the cecum and the terminal ileum for 2 or 3 in. in all directions. The ascending colon should be movable laterally for an inch or two, at least; often it and the cecum are extremely mobile. The hepatic flexure is not often within reach of the palpating fingers, although at times the right half of the colon is so very mobile that the cecum, ascending colon and hepatic flexure all can be pushed over to the left side of the midline. The transverse colon itself is rarely adherent; sometimes it is bound down in certain positions by adhesions of the omentum secondary to inflammatory disease or operative fixation of the omentum. The two legs of the hepatic loop, that is, the upper part of the ascending colon and the first part of the transverse colon, should be freely separable from each other. The same is true of the two legs of the splenic

loop, although it is extremely rare for adhesions to exist between the two legs of the splenic flexure. The descending

Indeed, in those days little was appreciated of the great value of the opaque meal examination in discovering ulcer and carci-

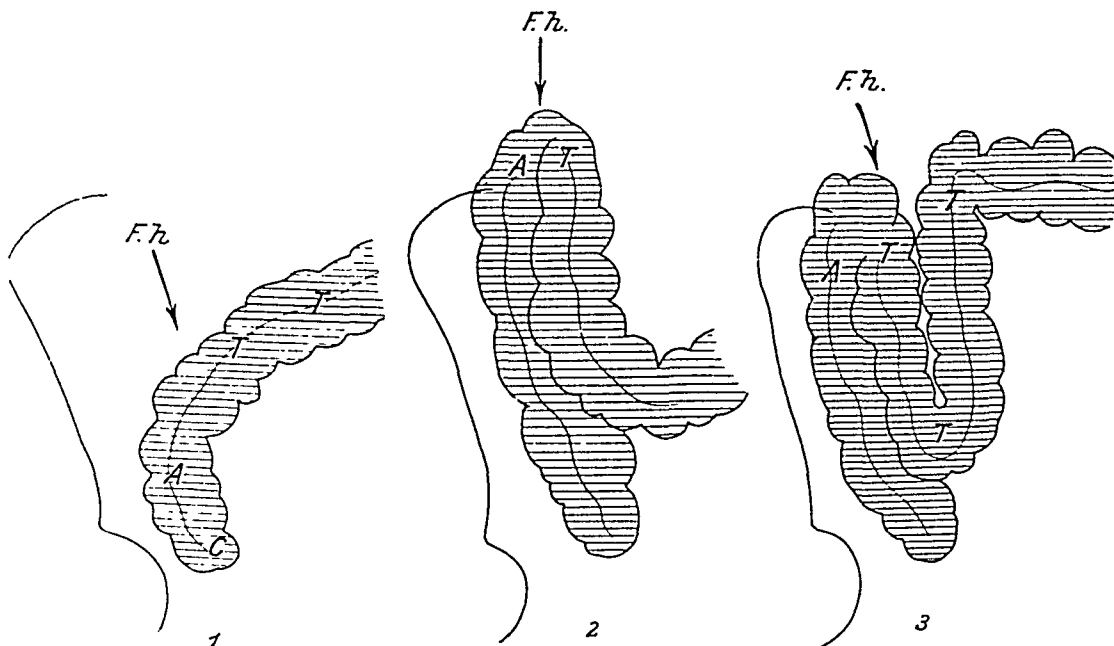


FIG. 5. Drawings from Schwarz illustrating variations in the disposition of the hepatic flexure.

and the iliac colon are usually fairly well movable, except at the junction between the two, the iliopelvic junction, where the mesocolon is normally very short. The mesocolon is also very short at the pelvirectal junction, but the pelvic colon itself should be very freely movable. In heavy patients it is not always possible to test the mobility of the pelvic colon by actual manipulation of its loops; but even in these cases, accurate deductions can be drawn for a comparison of the height reached by the pelvic loop during the filling of the colon by enema with that reached by it, following visualization by an opaque meal.

#### THE POSITION OF THE VARIOUS SEGMENTS OF THE COLON

In the early days of roentgenology the position of the colon, especially of the transverse portion, was a matter of considerable concern. It was perhaps the coincidence of the work of Glenard and the discovery of the x-rays which combined to impress undue importance on the morphological aspects of the abdominal viscera.

noma of the stomach and bowel; the determination of the position of the lower border of the stomach was the principal object of the x-ray study. As late as 1915 there were still relatively few who appreciated the tremendous importance of the investigations of Rieder, Holzknacht, Haudek, L. G. Cole, Pfahler and others in advancing roentgenology of the stomach from the stage in which interest centered on morphology to the high plane of ulcer and cancer diagnosis. In that year (1915) the following passage was printed in a prominent American medical journal: "The patient was brought in for a roentgen examination. The mixture of 3 oz. of barium sulphate and 12 oz. of buttermilk was given him and after a few minutes, a large picture of the abdomen was taken to *locate* the stomach." (*Italics our own.*)

Four hours after the meal, the protected palpating hand, pressing over the right lower abdomen, can separate the terminal ileum from the cecum and permit a study of their contours and mobility. The appendix may also be seen at this hour, though the eight-hour, or the twenty-four

hour observation is more propitious for finding and studying the appendix, and in many cases the later observation is better for investigating the cecum. Usually the lower end of the cecal shadow in the erect position lies about 2 cm. below the iliopectineal line. The cecum has a rounded form and is usually mobile in all directions because of its relatively long mesentery. The shape and position of the cecum is extremely variable in different individuals: the high cecum held up by congenital shortening of the ascending colon; the "cecum mobile" which is frequently found in the true pelvis instead of the right iliac fossa and all the different grades between these two extremes. Incomplete rotation of the colon, presenting an "inverted" cecum and other aberrations from the usual arrangement, will be discussed in a subsequent study.

The hepatic flexure varies considerably in length, position and in shape (Fig. 5). In some cases one sees the ascending colon merge directly into the transverse at a low point near the right iliac crest; in others there may be formed a loop of varying pattern which requires not only manipulation under screen guidance but also turning the patient in order to fluoroscope him at various angles.

In the transverse colon, one may see a variety of positions, not only in comparison of one patient with another but also in the same patient at different times. This will be fully described when discussing the large pendulum movements of Rieder (Fig. 6). Under palpation, on positional changes of the individual, and as a result of intrinsic peristaltic activities the transverse colon, even in the same individual, may assume all shapes from an almost straight w or a v to a stirrup-form or an inverted u. Rieder's large pendulum movements effect considerable change in position, curves and undulations of the intestinal tract without propelling its contents. All these changes are possible because of the long transverse mesocolon. As a rule, the transverse colon accompanies the

greater curvature of the stomach in any descent it may undergo. But, because of the variability of the length of the gastrosplenic omentum the reverse is not necessarily true: that a low position of the transverse colon means a low position of the stomach.

The splenic flexure is more nearly fixed than any other part of the colon; it is suspended high up near the left diaphragm, usually separated from it by the spleen, and forms what in the roentgenogram of the abdomen often looks like an acute angulation. As a matter of fact, this angle is seldom acute, as may be easily demonstrated by turning the patient somewhat on his right side. Lateral fluoroscopy shows very plainly that with very rare exceptions the splenic flexure forms a rather generous curve uniting the anteriorly located transverse colon with the posteriorly situated upper part of the descending colon (Fig. 7). Although the highest point of the splenic flexure usually coincides with the lower border of the spleen, one frequently sees the top of the splenic loop high up under the diaphragm, sometimes exhibiting marked redundancy. In case of such redundancy accumulations of gas in the splenic loop may cause real distress by knuckling the bowel sharply upon itself and producing a valve-like action with temporary obstruction.

The descending and iliac portions of the colon are usually short and straight, often empty and contracted, but sometimes containing the same kind of barium-mixed bowel content seen elsewhere. The descending colon is a conducting tube from the proximal colon into the lower sigmoid and rectal ampulla, and therefore often empty.

The pelvic colon is extremely variable in regard to size and position. In fact, it may be found in any part of the abdominal cavity. It may join the rectum either from the left or the right side or from above. The most common variations are illustrated in Figure 8. The pelvic colon may be very short, forming almost a direct line from the rectal ampulla

into the descending colon, a condition often encountered in obese individuals; on the other hand, it may be so long as to

# TECHNIC OF THE ROENTGEN EXAMINATION

An earnest effort should be made to

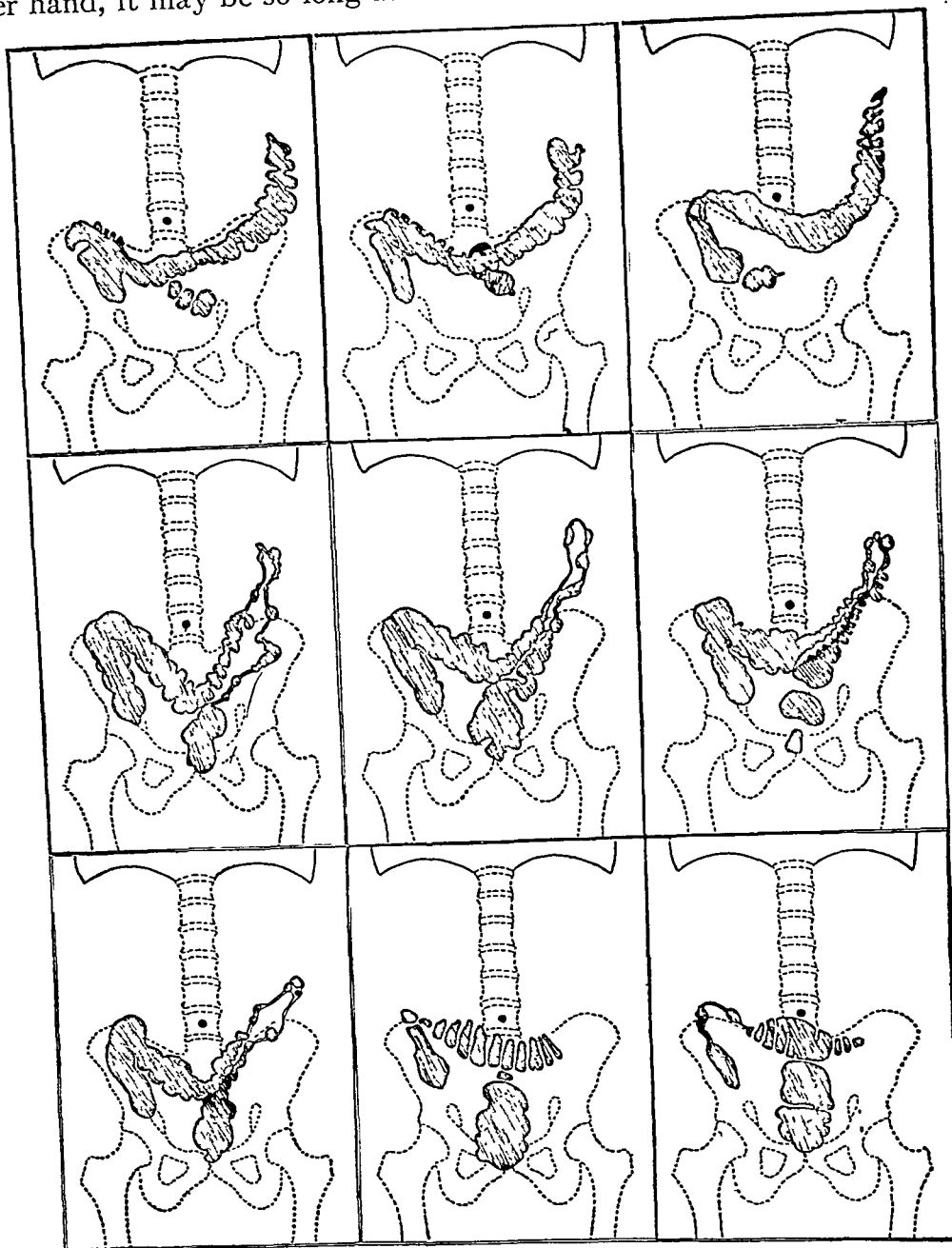


FIG. 6. Tracings from a series of roentgenograms by Rieder made at half-hour intervals, all conditions being the same except for the influence of peristalsis. Note the changes in the position and shape of the transverse colon, which Rieder ascribes to the "large pendulum movements."

reach higher than the transverse colon, lying in the right or left subchondral regions. In one of our cases the pelvic colon at operation measured more than 56 in. in length, the top of the loop lying in the gallbladder region. Not infrequently the pelvic colon enters into the sac of a left inguinal hernia.

follow a routine technic, modifying or extending the routine in certain cases as the circumstances seem to demand. The writer insists upon the importance of a complete alimentary tract study in every case, even though the trouble may seem to be localized in some one portion of the digestive tube. So often



one finds important bowel lesions clinically diagnosed as gastric disorders, and vice versa. Right upper quadrant symptoms,

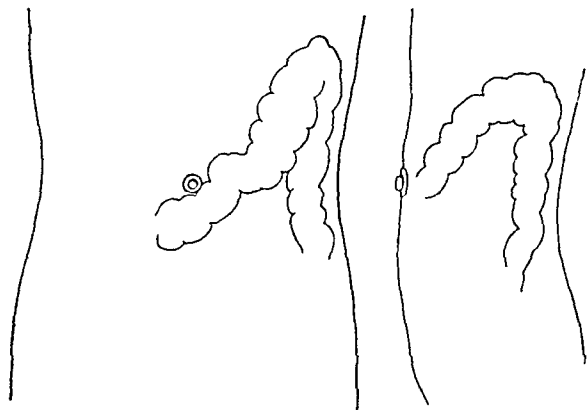


FIG. 7. Tracings showing that the splenic flexure usually forms a rather generous curve, when seen in the lateral projection, although in the anteroposterior projection it may simulate a rather sharp angulation. (After Schwarz.)

without any discernible organic basis, are extremely common in cases of lower bowel organic or functional disease and may be very misleading. Except in emergency cases, such as suspected acute obstruction, it would seem desirable that sufficient time be allotted for an adequate routine study. This means that three days, sometimes a four, should be planned on for an adequate study of the colon. Less time will result in proportionately less reliable work. A study of the function of the bowel must be carried out upon the functioning bowel and during this investigation the patient should carry on as nearly as possible according to his ordinary schedule of meals and physical activities. When an organic lesion is suspected, and the diagnostician wishes deliberately to overlook the functional aspects of the case, the time required for the study may be greatly shortened by giving an opaque meal to be taken at bedtime and seeing the patient the following morning for a study of the cecum and proximal colon, the distal colon to be studied during subsequent hours, or one may commence with the barium enema. The colon may be studied after air distension, after an opaque meal or after an opaque enema. Each of these means will be briefly described.

*Insufflation.* For gas distension of the colon an ordinary rubber bulb is fastened to a tube which the patient is asked to

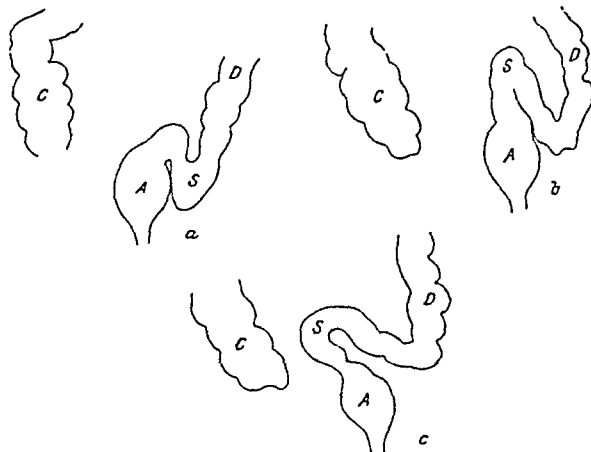


FIG. 8. Tracings showing three variations in the disposition of the pelvic loop. C, cecum. D, descending colon. S, pelvic loop. A, rectal ampulla. (After Schwarz.)

insert an inch or two into the rectum and, if necessary, hold there. Then, while the fluoroscopic screen is being observed, air is pumped in, visualizing very quickly and easily in order the pelvic colon, descending colon, splenic flexure, and on over to the cecum. The haustrated appearance of the colon is typical. The practical diagnostic worth of this procedure is limited, and its use confined to the differentiation of certain tumors or foreign bodies, or to set out more clearly the contours of some neighboring organ. The method is not without danger in some cases of stenosis, and is much less suitable for most purposes than filling the colon with opaque material.

*Contrast Studies.* The contrast material may be introduced into the colon either in connection with a meal or by an enema.

The writer recommends study of the colon following the meal as being more likely to give accurate information concerning the function of the bowel, reserving the injection of the opaque enema for those cases in which there is a question of gross obstruction (carcinoma, tumors, adhesions, etc.) and for testing the function of the ileocolic valve. Following the barium meal the studies of the colon

may be carried out at the eighth, twenty-fourth, thirty-second and forty-eighth hours, or at such other intervals as will best suit the program of the individual making the examination. An observation at the seventy-second hour is needed in many cases of diverticulitis. Other observations may be planned in special cases. Emphasis should be laid upon the advisability of generally adhering to a routine.

**Opaque Meal.** For the barium meal, any standard mixture with barium sulphate is acceptable. Formerly we employed a buttermilk suspension of barium sulphate. Rieder used a bread and milk mixture. At the present time there are a number of excellent preparations of barium sulphate ready for admixture with water and immediate use. Of course the opaque meal should be given on an empty stomach.

The following is Groedel's table relating to the passage of the opaque meal through the gastro-intestinal tract, giving the average time of the appearance of the shadow at the various points of the digestive canal:

	Visible	Empty or Passed Beyond
Duodenum .	5 minutes.	2 to 4 hours.
Jejunum..	15 minutes.	3 to 5 hours.
Ileum..	30 minutes.	4 to 6 hours.
Cecum.	2 to 3 hours.	6 to 24 hours.
Right flexure	4 to 6 hours.	
Left flexure..	4 to 12 hours.	
Rectal ampulla, at the latest....	.. 24 hours.	

Following a meal into which has been mixed 2 to 4 oz. of opaque material, the stomach should be empty within four and a half hours, at which observation the head of the barium column should have reached the cecum. The entire barium meal should have passed into the colon by the eighth, or at the most the tenth hour, when the head of the barium column should have reached at least as far as the middle of the transverse colon. The head of the barium column should reach the iliac colon from nine to sixteen hours following the ingestion of the meal, and the colon should be completely emptied

of the opaque material by the thirty-sixth to the forty-eighth hour.

Figures 9 and 10 illustrate the normal progress of an opaque meal through the alimentary tract.

Strict regularity in filling and emptying is not observed in the colon as it is in the stomach and it is difficult to fix any normal standard. Generally speaking, we may accept as a fact that within twelve hours after an opaque meal nearly all parts of the colon except the rectum should be visualized.

The appearance of the opaque meal in the colon is variegated. The haustra produce a segmentation of the colonic contents, most pronounced in the transverse but seen more or less throughout the large bowel. In the cecum the opaque masses form a cylindrical structure, usually with a rounded bottom, but varying greatly in the shadow pattern. The segmentation seen in the transverse colon gives the appearance of a festoon of leaves, likened by Schwartz (Fig. 11) to a figwreath; on other occasions they are separated from each other in a dumb-bell form. As we near the splenic flexure and in the descending colon boluses are more round and separated in a typical manner or crowded into a conglomerate mass. In the sigmoid definite masses begin to appear in coherent sausage-like forms, and in the rectal ampulla one sees the characteristic symmetrically formed mass.

For the *opaque enema* most radiologists prefer some modification of the method of Haenisch. The Haenisch enema consists of bolus alba 300 gm., bismuth carbonate 75 gm., and water sufficient to make 1 liter.

The writer for many years used the following formula: To 2½ dr. of gum tragacanth, add about 1 oz. of alcohol. Shake well. Add 20 oz. of warm water and shake. Add 3 oz. of barium sulphate, then 20 oz. of water shaking well each time. This mixture should be made up fresh shortly before using.

Holzkecht and Singer give the following formulae: (a) Barium sulphate clysma. To 1 l. of boiling water, a suspension of 2

a suspension of two tablespoonfuls of finest potato starch in a quarter of a liter of cold water is added. This is boiled

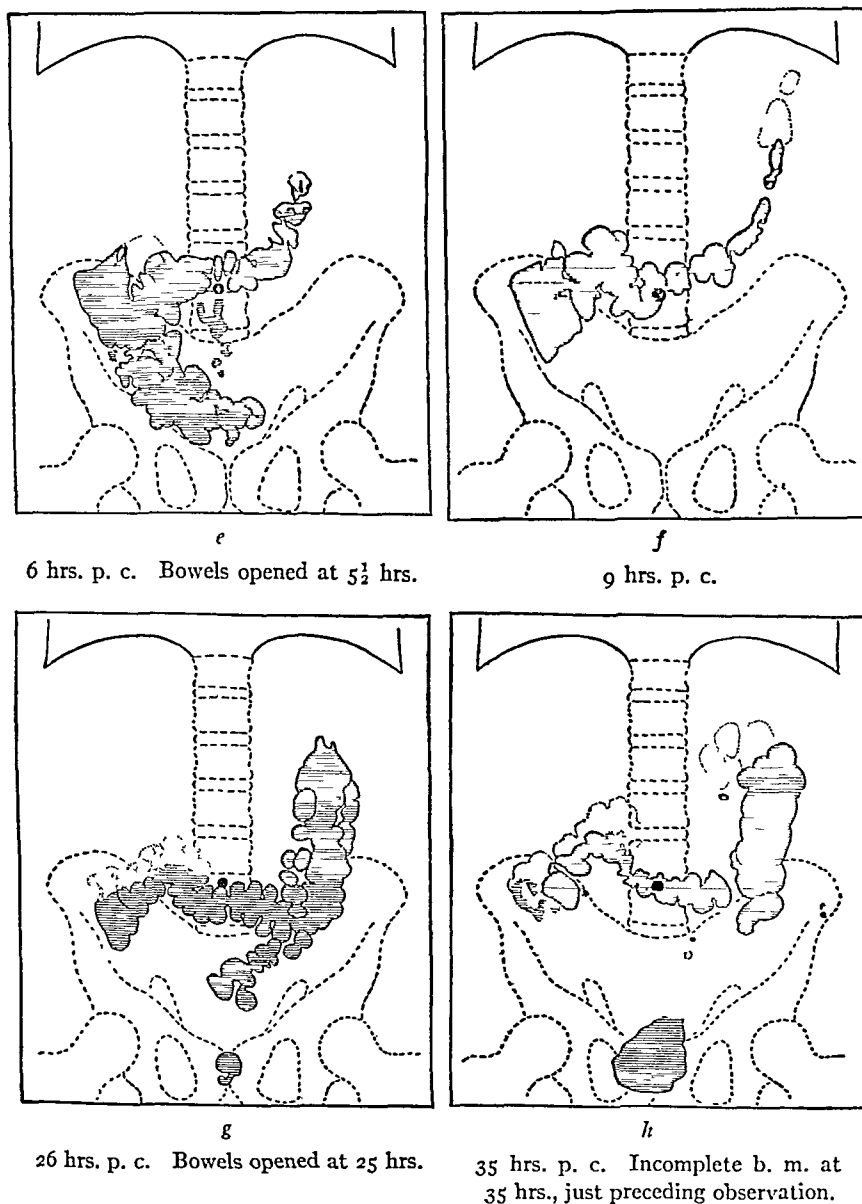


FIG. 9. Drawings from actual cases representing the average transit of opaque material through the bowel in healthy individuals.

soup-  
spoonfuls of finest potato starch in three-fourths of a liter of cold water is added, and after being boiled again, 160 gm. of barium sulphate and  $\frac{1}{4}$  l. of hot water is stirred with it. The mixture is then boiled for five minutes and cooled off to 112°F. This mixture can be preserved in the icebox for several days. (b) The bismuth clysma. To 1 l. of boiling water,

again for five minutes, and 120 gm. of bismuth carbonate stirred in three-fourths l. of cold water is added to it without boiling again.

Ordinary buttermilk, warmed to the temperature of 100°F., serves very well as a vehicle for the suspension of the barium for enema purposes. The latter preparation has the advantage of being

quickly prepared. There are various proprietary brands of barium sulphate on the market ready prepared for admixture with

of the injection varies with the importance of the segment to be explored. A liter usually suffices to reach the splenic flexure.

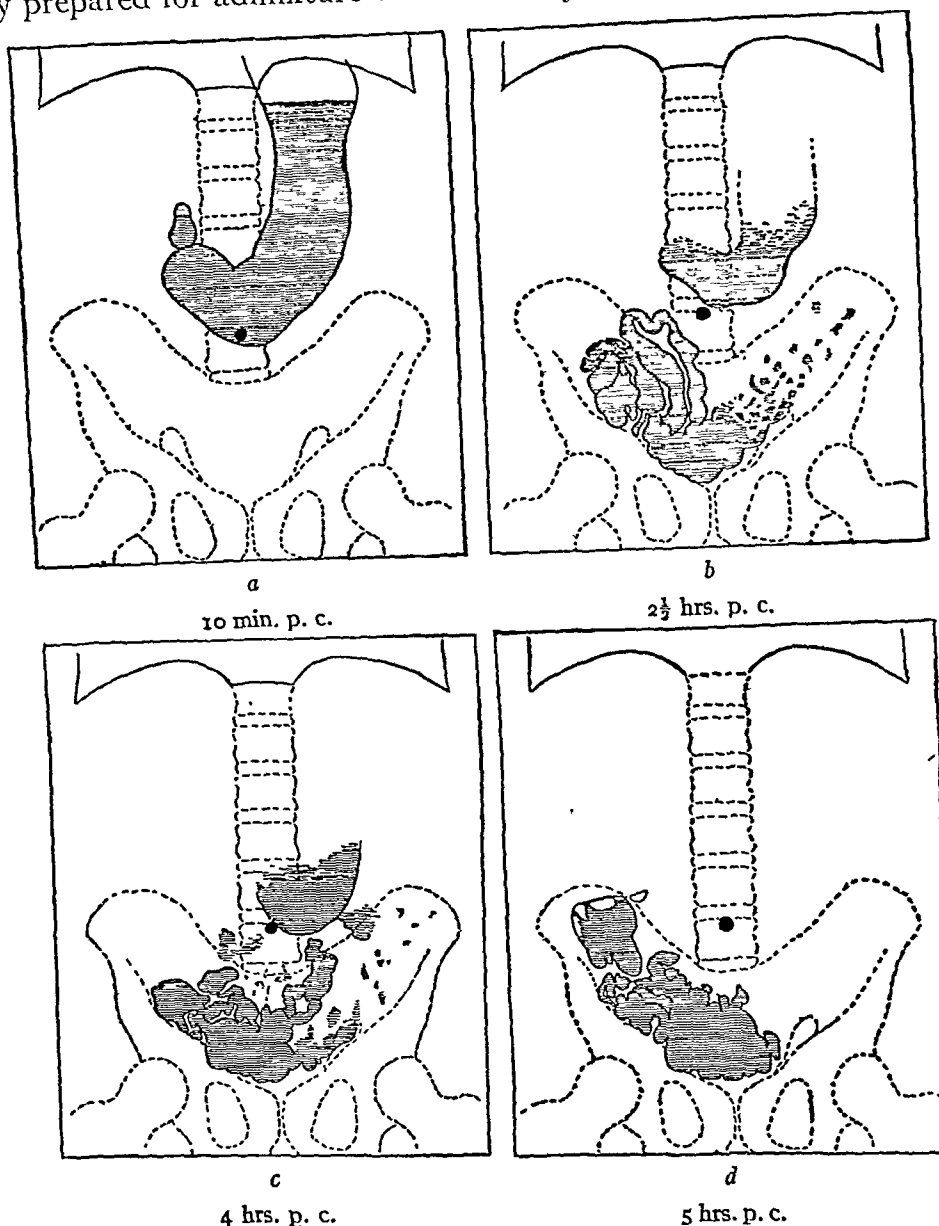


FIG. 10. Drawings from actual cases representing the average transit of opaque material through the bowel in healthy individuals.

hot water, so one need never be obliged to keep a patient waiting for lack of the materials for an opaque injection of the colon.

Jaugeas and Friedel recommended a paste, especially for the investigation of the rectum and sigmoid. Their paste consists of a mixture of vaseline and oil in equal parts, to which barium sulphate or bismuth carbonate is carefully incorporated in equal parts. This preparation can be injected with a syringe. The quantity

The technic observed during the injection of the opaque enema is not complicated. A preliminary cleansing enema given two or three hours before the opaque injection is usually advisable. Some radiologists prefer a mild laxative in place of the cleansing enema.

An ordinary enema container, with a capacity of 2 qts. and with 6 or 7 ft. of tubing attached, is suspended at a height of 2 or 3 ft. above the horizontal fluoroscope. At the middle of this tube should be

introduced an ordinary bulb syringe, with clamps upon the rubber tubing above and below this bulb. This syringe will be needed

come from below, illuminating a screen which lies upon the patient's abdomen or is supported above it. In this way the

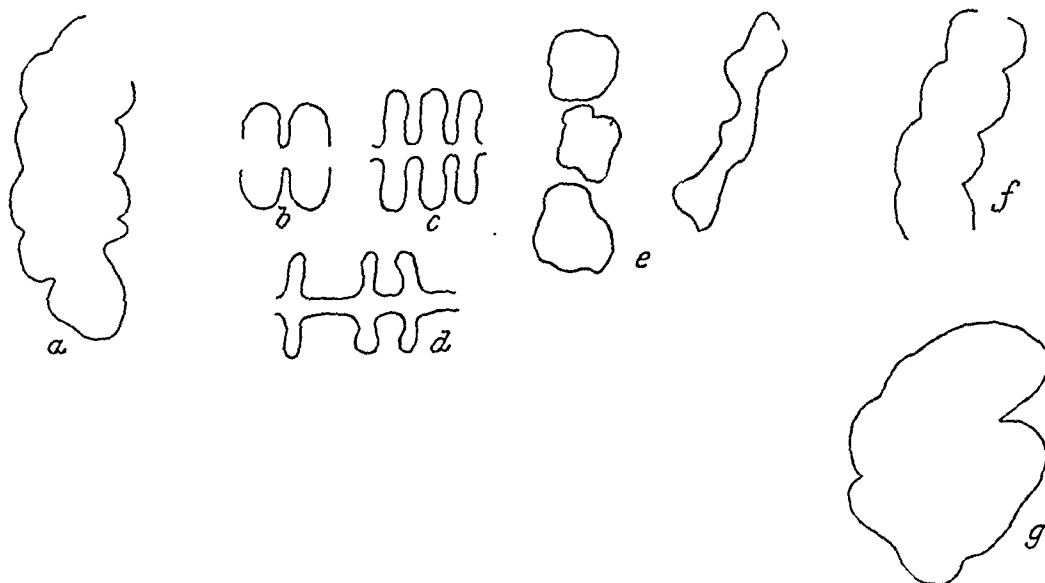


FIG. 11. Characteristic shape of the opaque mass in various segments of the colon (after Schwarz). a, ascending colon and cecum. b, c, d, transverse colon. e, splenic flexure. f, pelvic colon. g, rectal ampulla.

to make sure that no air is introduced into the colon, to clear out the tube of sedimented barium from time to time, and to supply additional force for the injection should it be required. The enema tip is an ordinary glass tube about 3 in. in length, supplied by pharmacists for the purpose. Since glass is breakable, it is perhaps better to employ hard rubber or metallic enema tips. A supply of sterilized glass or other enema tips should be kept on hand, so there will be no delay in changing tubes for a series of examinations in quick succession. The writer ordinarily keeps in a jar of mild antiseptic solution a half-dozen enema tips each attached to a foot of rubber tubing ready fitted with a glass connector; at the close of one examination by opaque enema, it is only necessary to exchange the used enema tip and terminal foot of tubing for a fresh tip with its clean tubing, thus avoiding the necessity of renewing the entire enema equipment.

In having the barium enema administered, the patient lies supine upon the horizontal fluoroscope, so that the rays

progress of the injection can be watched as the fluid enters. The rectal point is inserted by the patient himself, but not more than an inch or an inch and a half. When a rubber tube is pushed up too high into the rectum it folds upon itself and sometimes kinks and prevents the entry of the injection. Furthermore it is unnecessary to use any form of tube intended for high insertion into the colon. The so-called high enema is easily given with the means above described, and with the patient lying flat on the back. It is quite unnecessary to use long colon tubes with prolonged and often painful, usually futile, attempts to insert it through the pelvic colon well into the descending colon, in order to give a high enema. The attempts to make a high insertion of a colon tube in the belief that it can and should be introduced into the proximal large bowel in by far the great majority of cases, result in failure to reach the high point desired and at the same time cause pronounced overdistension of the pelvic colon.

It is of fundamental importance that the injection of the opaque enema shall be

controlled by fluoroscopic observation. Failure to do so, as in the case illustrated herewith, may lead to serious error of inter-

the current only at the exact moment his eyes are intently focused upon the field to be studied; the current should



FIG. 12. Appearance of right half of colon, with incomplete filling by opaque enema. Wrong interpretation would have resulted from failure to note that the filling was incomplete. (See Fig. 11.)

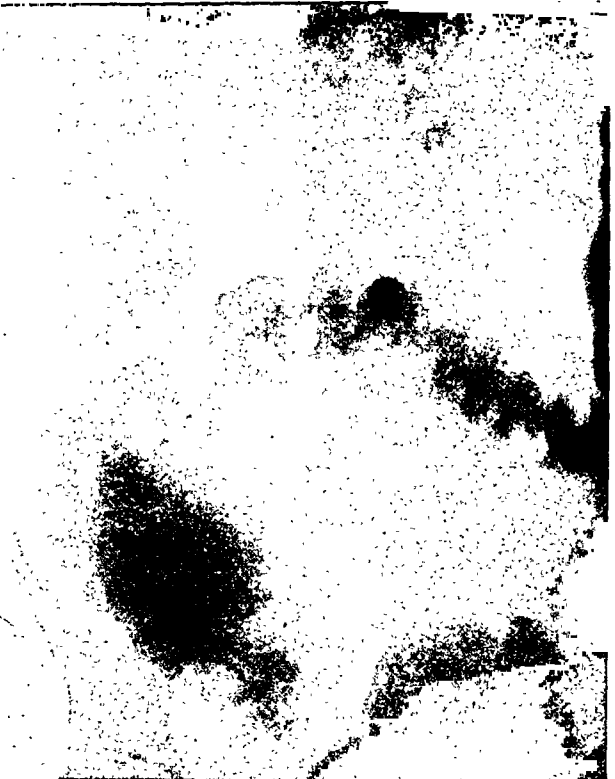


FIG. 13. (See Fig. 10.) Complete filling of the right half of the colon shown in the preceding illustration, correcting what would otherwise have been a wrong interpretation of inverted cecum.

pretation. Figure 12 shows the appearance of the right half of the colon when the filling was thought to be complete and the conclusion had been reached that the patient possessed an anomalous cecum with inversion. Figure 13 shows the cecum as it really existed, after fluoroscopic proof that the cecum had been completely filled. It is sometimes helpful to turn the patient on the right side for a few moments at the termination of the injection to make sure that the filling of the cecum is satisfactory.

As in all fluoroscopic work, no observations should be attempted until the eyes have been in the dark for a sufficient length of time, so that the enema tube in the rectum can be readily seen. At least ten minutes are required for this preparation of the eyes, and often longer. The observer uses the foot-switch to turn on

not be allowed to illuminate the tube a second longer than required for the necessary observations. The stopcock is opened and the study begun. In normal cases there appears in the pelvis a pear-shaped shadow which gradually increases in size, showing the filling of the ampulla. The distention of the ampulla having been accomplished, the opaque fluid begins to seek an outlet into the pelvic colon. Whether or not we shall be able to see distinctly the pelvirectal junction and the last inch or two of the pelvic colon depends upon the location and disposition of this portion of the large bowel; according to its variable position the outlet from the ampulla appears sometimes toward the right, sometimes in the middle, and sometimes toward the left. When it appears toward the left it is usually possible to distinguish the pelvirectal angle very

well, especially if the patient be turned slightly so that oblique illumination can be employed. When it appears toward the

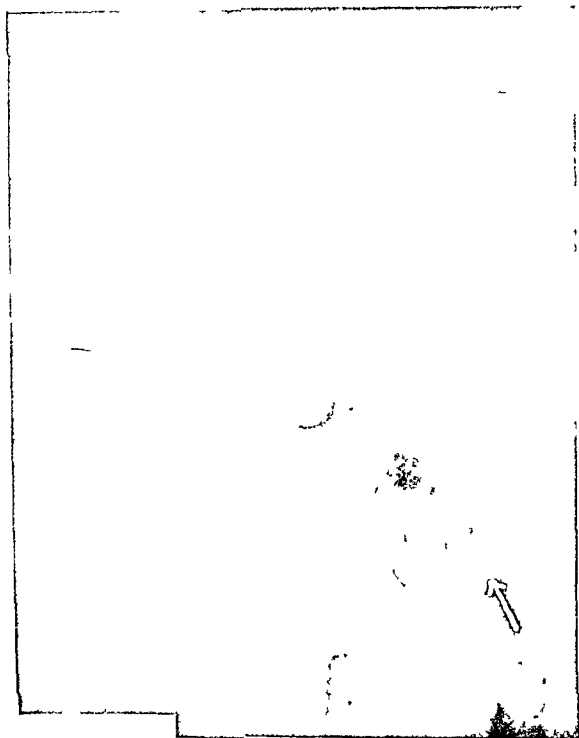


FIG. 14. Distention of the colon by air insufflation, to bring out and better identify the diverticula recognized by retained barium from a previous barium meal.

right or in the midline, the shadow of the opaque mass in the ampulla obscures the vision. In certain cases studies by means of stereoscopic films are exceedingly helpful.

It should be remembered that in almost every case, where the enema is injected with the patient in the supine position, there will appear to be a narrowing of the bowel where the pelvic loop passes the ilipectineal line at its junction with the iliac colon. The appearance of narrowing is often exaggerated by the very short mesocolon possessed by this segment of the large bowel, and especially by the adhesions which often exist at this point. There first appear in the van of the advancing column several relatively small boluses, showing the regular spacings due to the indentation of the haustra coli. Under the increasing pressure, however, these haustral markings are smoothed out and the

bowel shadow becomes broader, darker and homogeneous. The normal pelvic colon rises higher in the abdomen during the injection of the enema, owing to the increasing pressure. When the rise of the pelvic colon fails to occur, it may be taken as evidence strongly suggestive of adhesions binding it down.

After entering the pelvic colon, and particularly after passing the iliopelvic junction into the iliac colon, the progress of the opaque stream is uninterrupted. The enema usually flows quickly up the iliac and descending colon, where it follows a course backward over the iliac crest, upward and forward around the splenic flexure, forward and downward across the transverse colon to the hepatic flexure. There is normally the appearance of retardation of the opaque stream during its passage around the splenic flexure. This is only apparent, as will be appreciated very easily if the patient be examined in the supine position with a tube placed laterally, the screen being held vertically against the left side. Or, if the colon be studied stereoscopically, the two legs of the splenic loop (the last portion of the transverse and the first portion of the descending colon) are seen to be widely separated, the descending colon lying far dorsally to the last third of the transverse colon. The kinking which is supposed to occur often in the splenic flexure is rarely very sharp, but in those cases where it does occur the progress of the enema may be hastened by turning the patient upon the right side for a few moments. In the great majority of cases, however, it will not be necessary to turn the patient from the supine position in which the injection is started.

In the transverse colon it is sometimes observed that in the midline in front of the spine there is an apparent filling defect due to the saddling of the colon over the spinal column. This is especially noted in cases of increased intra-abdominal pressure.

In the hepatic region the fluid sometimes

is observed to follow a very devious course (Figs. 5, 12, 13), indicating a redundancy of the bowel at this point. Very rarely indeed is there any real kinking even when adhesions are numerous. Occasionally the fluid passes directly into the ascending colon, especially in well-nourished individuals; often it flows first upward in a direction parallel with the ascending and to its outer side, but later it returns and enters the ascending. Now the opaque fluid spreads rapidly, filling the ascending colon and the cecum, usually without difficulty. When the ileocolic valve is competent, the enema stops at the cecum; but in the rather large percentage of cases in which the valve is found insufficient, the terminal coils of ileum are seen to fill for a greater or less distance.

In brief résumé, it may be stated that the normal colon can be filled by injection within a few minutes, the patient reclining upon the back, without elevation of the pelvis or the use of the colon-tube. There are certain physiologic obstacles which can be overcome by waiting, by manipulation, and sometimes by change of position. The greatest expansion is noted in the ampulla and sometimes in the cecum. Excepting the ampulla, the caliber of the colon, thus filled by opaque enema, gradually increases from about 3 cm. in the pelvic colon to 6 cm. in the cecum. The larger the amount of the injection, the more redundant the colon, for it expands not only in breadth but also in length.

Normally, the opaque enema, which is perfectly bland and unirritating, proceeds through the entire colon to the cecum without exciting any visible peristaltic contractions; but in the conditions of inflammation or overdistention characteristic ring contractions may be excited. When seen, these have diagnostic value. Sometimes they may cause confusing pseudo-filling defects. Normally several minutes elapse without such peristaltic waves, even after the head of the enema column has reached the cecum. The

haustral markings which have been smoothed out during the entry of the enema, usually return after a little time,

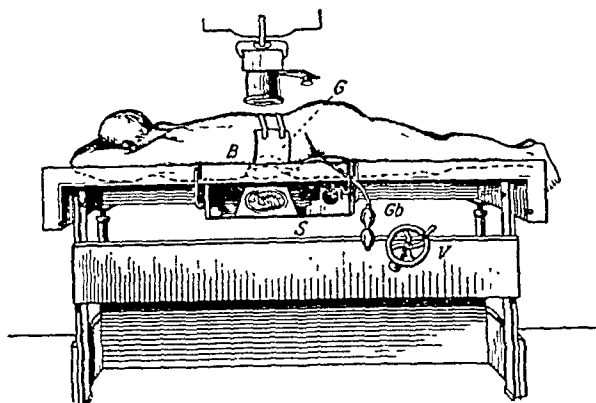


FIG. 15. Chaoul's Balloon-Belt Compressor, for bringing out the details of the rugae or other mucosal markings in the stomach or colon.

occasionally in an instant, but usually more slowly, beginning first in the distal colon.

Following the study of the enema-filled colon, we often find it very instructive to watch the emptying of the enema or to study the colon immediately after the expulsion of the enema. Haenisch advises that the container from which the injection has been made be lowered, and the enema allowed to return by gravity. The emptying of the colon is thus watched under the screen. This is often very inconvenient, however, and most of the aid thus obtained can be secured by a screen study immediately after the patient has expelled the enema. It is of great importance that the roentgen installation for fluoroscopic work should be so arranged that at a moment's notice a film record may be made of any desired phase of the radiosopic appearance. This is especially needed during the study of the pelvic loop, for, if the making of this record be postponed until the entire colon is filled, the turning of the patient toward the left to secure the necessary obliquity of irradiation to show up the iliopelvic junction, may throw the shadow of the large cecum and often also that of the terminal ileum over the shadow of the rectal ampulla and lower sigmoid, thus causing a tangle



of shadows almost impossible to unravel. It is our custom to make 8 by 10 in. film records of the rectosigmoidal junction just as soon as it is visualized, without waiting for the head of the enema column to fill the descending colon; if we wait until the opaque column of injected fluid reaches the cecum, the shadows of the cecum and terminal ileum may overlap the shadows of the pelvic loop and obscure it, thus leaving a chance of overlooking important pathological changes. After the entire colon has been filled, a large film record should be made in the usual prone position; this and the smaller films made during the course of the injection provide a complete record of the colonic morphology which may be studied at leisure.

Recent publications have brought out several modifications of the ordinary barium enema which if expertly carried out seem to add points of value to the examination with the opaque injection. Fischer recommended the inflation of the colon with air after the introduction of the opaque material in as small a quantity as compatible with arrival of the head of the enema column at the cecum. The contrast secured by the inflation of the colon brings out more distinctly lesions visualized by the opaque mixture (Fig. 14).

H. H. Berg, H. Chaoul and others have published beautiful roentgenograms secured after making very strong local compression over the part of the bowel under suspicion either after an opaque meal or after an opaque clysma. The compression is secured by a belt-balloon device (Fig. 15), which is strapped about the patient's body, the patient placed in proper position on the radiographic table, and the compression made by pumping air into the balloon until the satisfactory degree of localized pressure

is secured. The relief-pictures obtained in this manner show with an extraordinary wealth of detail the appearance of the mucous lining of the alimentary tract, and permit the recognition of earlier lesions than is possible with the older irrigoscopic methods.

As above stated, in order to be thorough and to adhere to a routine, the writer prefers to examine the colon both by opaque enema and by opaque meal in every case. When the clinical evidence seems to indicate a colonic lesion of an organic nature, it is probably best to begin with the opaque clysma in order to avoid if possible filling the colon above an organic obstruction with opaque material. When the findings following the barium meal seem to point to obstruction in the colon at a certain point, testing the colon by opaque enema will give additional evidence of considerable value and serve as a reliable check upon the barium meal findings. Observation of the colon immediately after the expulsion of the opaque enema will still further control records already made.

The roentgen method, when carried out in the thorough way just outlined, in the hands of experienced radiologists will give findings which are nearly always correct. If an organic lesion obstructs, or if it is sufficiently large to produce symptoms, it ought not to be overlooked, and in a number of instances we should succeed in locating a tumor of the colon before it gives rise to symptoms.

In a subsequent issue of this journal, the writer will describe in detail our present knowledge of the motor function of the colon, and the importance of keeping in mind normal motor manifestations while interpreting roentgenograms of the colon.



# BETTER PROTECTION IN VERTICAL FLUOROSCOPY\*

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OF ALL radiological technical procedures screen examinations are the most dangerous; in fact, at present fluoroscopy is the only phase of radiological investigation or therapy in which it is almost impossible to secure efficient protection for the radiologist. It is true that with a modern, well-organized installation, radiography and radiotherapy no longer threaten with danger those who utilize them. In my own hospital the French Government has spared no expense to endow the newly installed radiological services with apparatus affording the necessary protection. It is to be hoped that the older laboratories may soon have their older equipment superseded with modern instruments; the lives of the radiological staff may depend on such a renovation of old equipment.

Fluoroscopy, on the other hand, especially in the upright position, presents grave dangers for the radiologist. These dangers are of three classes:

1. Danger of electrocution attending the use of the high tension current.
2. Danger from direct irradiation, that is, absorption by the fluoroscopist of some of the x-rays emanating from the tube, by placing his body or a part of it in the direct pathway of the active rays.
3. Danger from absorption of secondary rays emitted by the substances encountered by the direct x-rays. The body of the subject being examined constitutes the most important source of secondary radiation.

Under present day conditions of fluoroscopic work, electrocution is rare but possible; we are sadly aware of some tragic examples. Its infrequency is due more to the suppression of certain models of particularly dangerous generators than to the employment of safety devices which are still imperfect. One can never be sure of protection from accident should a high ten-

sion wire unfortunately become detached and come in contact with the radiologist by the intermediary of some metallic piece.

Protection against direction radiation is more easily secured. The manufacturers should be obliged to construct all radioscopic apparatus in such a way that the screen or its opaque mounting should always exceed in size the dimensions of the illuminated field. The apparatus at present in use do not satisfy this condition. Everyone knows that if he opens the diaphragm somewhat quickly the bundle of rays becomes larger than the screen and exposes the observer to radiation. This is a grave fault of construction against which too loud a protest is scarcely possible. Furthermore, the lead glass covering of the fluoroscopic screen should be of a satisfactory quality and thickness, and the mounting of the screen should not be defective, permitting a gap of several centimeters for free passage of the rays.

The secondary radiation emitted by the subject under examination and by all objects which surround him, is considerably more harmful. I have on numerous previous occasions called attention to this fault, and by careful observance of the skin damages suffered by various radiologists I have demonstrated the reality of the danger from secondary radiation.

I have recently announced the realization of an efficiently protected fluoroscope instrument for examination in the vertical position, the principle of which I shall set forth in subsequent paragraphs. The purpose of the instrument is to insure absolute protection for the radiologist and his assistants:

1. Against high tension current accidents (including unintentional contact with a high tension conductor.)
2. Against direct radiation originating in the x-ray tube.

\* Submitted for publication March 20, 1930.

3. Against secondary radiation, of which the patient is the principal source. To accomplish this, I have divided the

opening of its door cuts off the primary current.

2. A dark room reserved for the radiol-

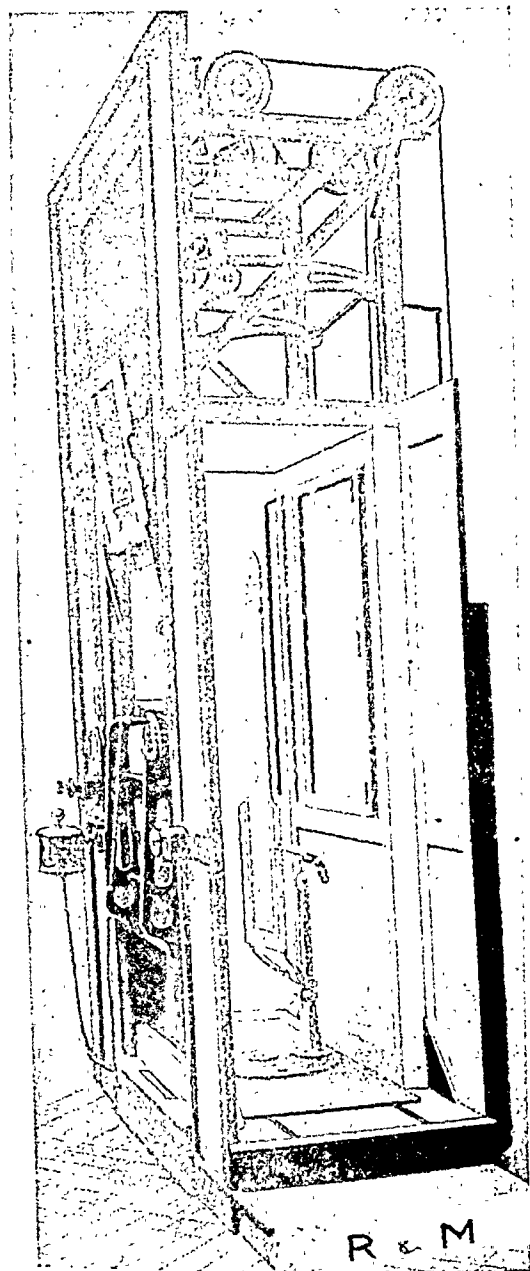


FIG. 1. Lateral view of Belot's safety upright fluoroscope.

installation of the vertical fluoroscope into three parts:

1. A separate cabinet which can be left lighted is strictly reserved for the generating apparatus and for the tube which produces the x-rays. No one has access to this place while it is dangerous, for the

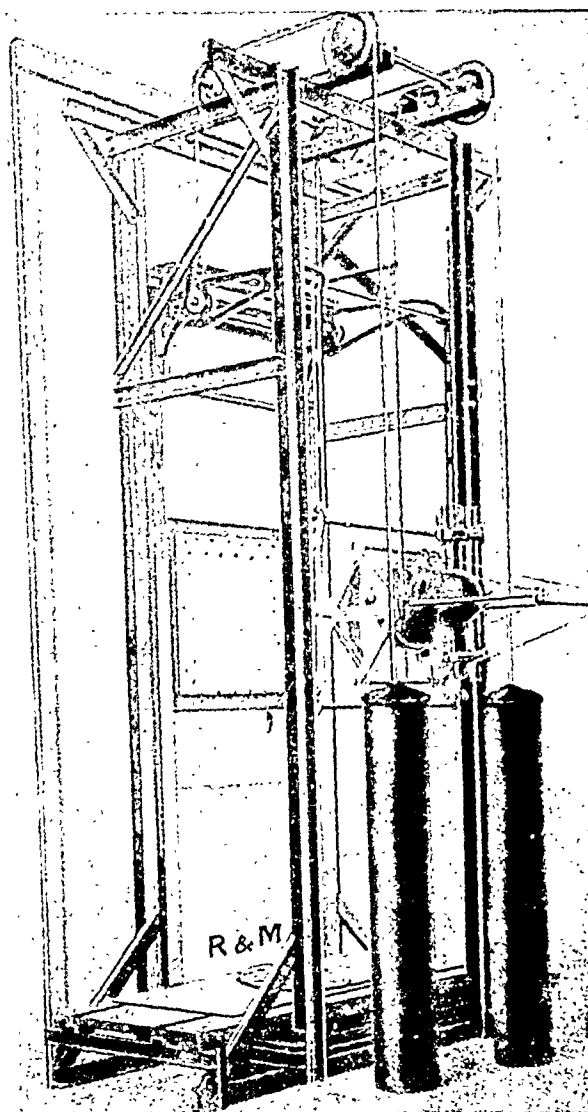


FIG. 2. Rear view of Belot's safety vertical fluoroscope (rear panels of protective material removed for the photograph).

ogist and his assistants: This contains the screen and all the control apparatus.

3. Between these two chambers is a clear corridor, reserved for the patient, which he may enter easily under the guidance of a nurse who is herself protected.

The walls of each of these chambers are fitted with windows conveniently arranged to permit free passage of the useful bundle of x-rays necessary to illuminate the screen placed in front of the physician.

The chief difficulties of the problem grew out of the necessity of correlating the movements of the patient and of the tube, a control so necessary for fluoroscopic examination.

I first set myself the task of arranging to move the patient only, leaving the tube and the screen fixed and in proper relation to each other. But the construction of a platform permitting displacement of the patient in all directions was very complicated and costly. I may add that certain patients, especially injured patients, found it very difficult to tolerate the movements brought about in this manner.

So I gave up this idea for the following: The patient placed on a movable platform executes mechanically all lateral and rotating movements; the tube and the screen, invariably fixed in relation to each other, can be raised higher or lower, thus making unnecessary any movement of the patient in the vertical direction. It is possible with this device to direct the radiation through various obliquities.

Thus, upward displacements are assured by simultaneous movement of the tube and screen; the incidence of the rays is modified by the obliquity given to the useful bundle by inclining the tube; the patient is moved laterally by lateral movements of the platform on which he is placed; orientation is secured by rotating the platform. All these movements are necessarily brought about at a distance by electrical and mechanical devices under the control of the radiologist.

To the control of these movements must be added command of the size of the opening of the diaphragm, and of the anticathode-screen distance, to say nothing of the control of the electrical apparatus furnishing current to the tube.

From his place, without effort, the radiologist has under control of his left hand the height of the tube and screen. The movements of the patient, the opening and closure of the diaphragm by means of one hand, combined, simulate reflex movements.

This installation presents an absolute security for the radiologist and places the patient and the operator in safety



FIG. 3. Belot's safety vertical fluoroscope seen from the operator's side.

from all danger of electrocution. Furthermore, the patient who remains in the lighted corridor is not unfavorably influenced and his organism functions under normal physiological conditions. There is no difficulty in examining children with this apparatus. I may add that the cleaning and warming of this corridor are easy without imposing an excessive temperature on the radiologist or his aids.

Efficiently installed, this system permits rapid service for the successive and uninterrupted passage of patients, entering at one end of the corridor and leaving by the other. During the change of patients, the physician and his assistants remain in the obscure room, without spoiling their accommodation.

# AN IMPROVED UTERINE RADIUM APPLICATOR\*

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THE AUTHOR, sometime ago,<sup>1</sup> designed a radium uterine applicator, especially adapted to treating uterine

ual canal length, thereby irradiating the entire uterus.

3. Heavy filtration, greater in the vagi-

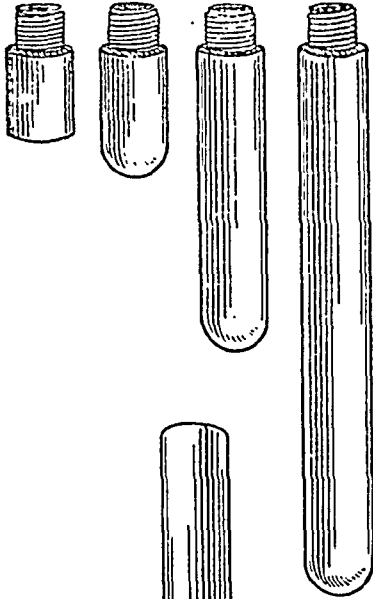


FIG. 1. Individual parts of the original applicator.

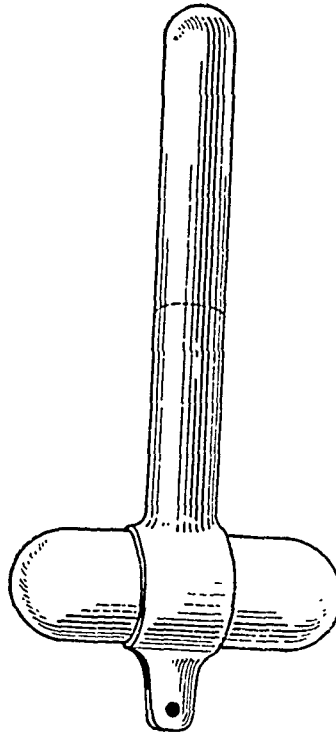


FIG. 2. Original applicator assembled for use in a uterine canal of average length.

malignancy in accordance with the technic of Regaud (Associate of Madame Curie), of the University of Paris. The principles involved in the use of the instrument are:

1. It permits irradiation to the entire uterine canal from multiple radium centers, one center supplying radiation in the vagina.

2. Adjustability. Uterine canals of different lengths can be easily radiated by assembling the applicator to fit the individ-

ual portion of the instrument than in the uterine part, thus protecting the sensitive vaginal mucosa, and minimizing the danger of formation of fistulas.

The original instrument, now known as Applicator No. 1, is constructed of 22 karat gold of special alloy (density 18.4) covered with aluminum. Filtration in the uterine portion is equivalent to 1.5 mm. of pure platinum and 3 mm. in the vaginal part. Gold is substituted for platinum (density 21.4), because of its almost equal density, and, because it costs only about one-fifth the value of

<sup>1</sup>Swanberg, H. A new radium applicator for carcinoma of the cervix. *J. A. M. A.*, 90: 1289, 1928.

\* Submitted for publication March 17, 1930.

platinum, lowers greatly the construction expense of the instrument.

Certain radium therapists questioned

has been reduced to 1.9 mm. This instrument necessitates, however, the use of small-sized radium needles in tandem

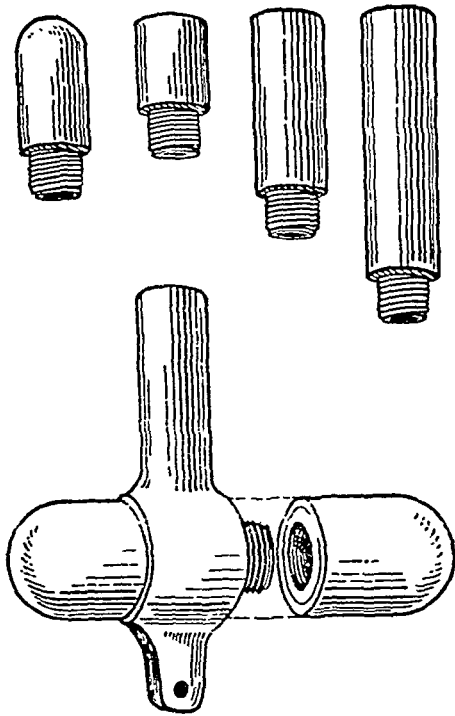


FIG. 3. Individual parts of applicator as now made. (Note but one end-piece and three sectional parts.)

the advisability of using such heavy filtration; hence an applicator of slightly lighter density and somewhat smaller dimensions was devised, known as Applicator No. 2. This applicator is also constructed of gold covered with aluminum. The filtration is equivalent to 1 mm. of pure platinum in the uterine portion and 1.5 mm. in the vaginal part. (This filtration is the same as that now employed by Regaud.)

In order to materially reduce the cost of the applicator, and still provide comparatively heavy filtration, a third instrument, designated as Applicator No. 3, has been devised. This is constructed of brass (density 8.4) instead of gold, and covered with aluminum. Applicator No. 3 has a filtration equivalent to that provided in Applicator No. 2, and it is approximately the equal, in outside dimensions, to Applicator No. 1. In order to keep the uterine portion of this instrument within practical dimensions, the central bore

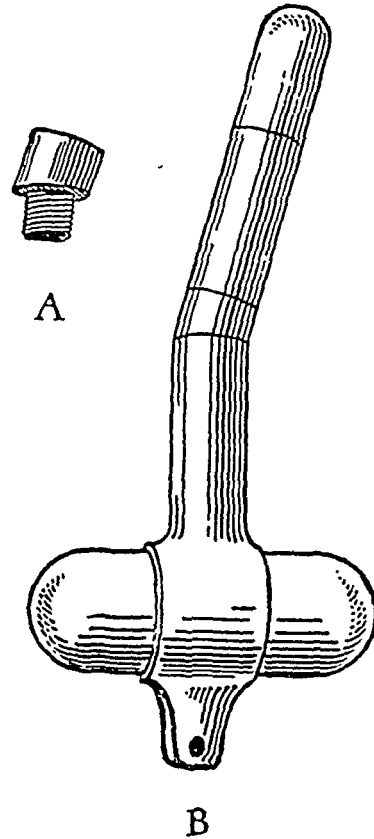


FIG. 4. A. Uterine angle-wedge. B. Appearance of applicator with a 15° uterine angle-wedge in position.

arrangement. (The central bore of the uterine portion of Applicators No. 1 and No. 2 is 3.5 mm.)

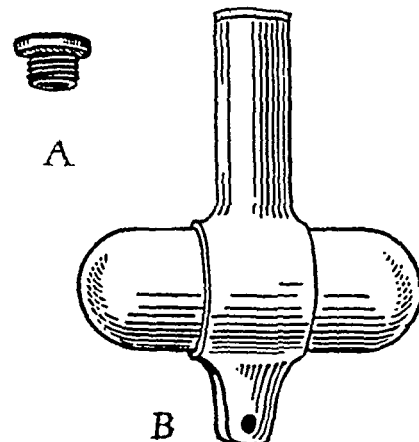


FIG. 5. A. Uterine collar-button end. B. Appearance of applicator with uterine collar-button end in position to treat a short cervical canal.

A number of additional improvements in the applicator have been made.

This applicator was originally provided with three separate uterine end-pieces of variable size, and one short uterine

one uterine end-piece and there uterine sections of variable size.

Some gynecologists object to the use

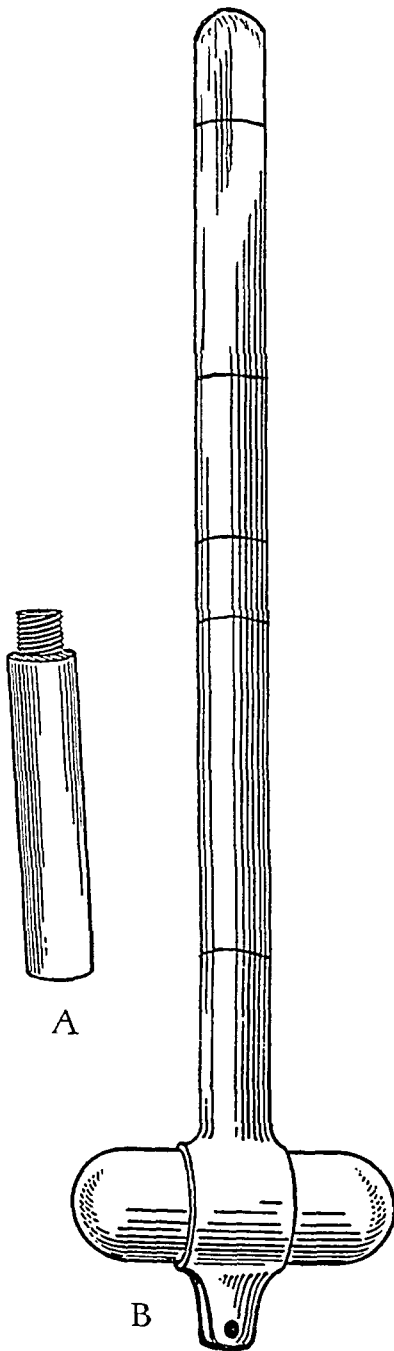


FIG. 6. A. Uterine extension part (made in various lengths). B. Appearance of applicator with uterine extension parts assembled to treat an unusually long uterine canal.

section. Increased flexibility with decreased cost has been secured by providing but

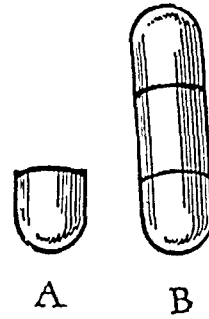


FIG. 7. A. Screw-cap for uterine extension sections. B. Capsule made by screwing screw-cap on the uterine extension end.

of a long straight instrument in the uterus and contend that all such devised should be curved or so constructed as to more nearly conform to the direction of the uterine canal. This has been overcome by the construction of an angle-wedge, which can be attached to the applicator. Several types have been provided so

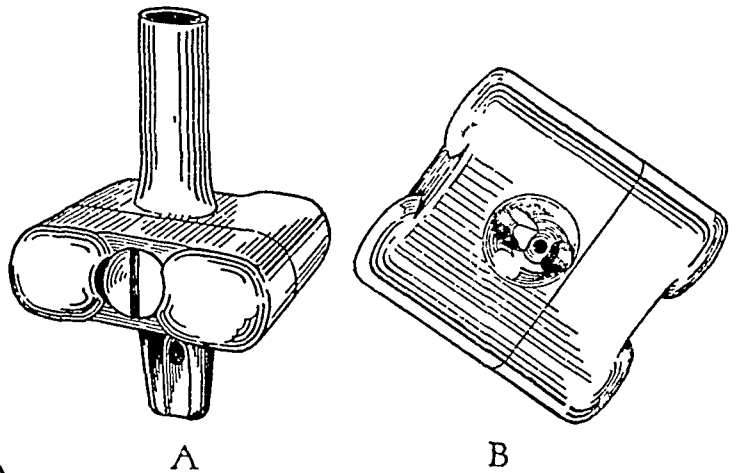


FIG. 8. A. Side view. B. End view. The double vaginal end for the applicator.

that angles of  $10^\circ$ ,  $15^\circ$  or  $20^\circ$  are obtained in the uterus. We have also devised an adjustable uterine angle-wedge so that the direction of the angle, in relation to the vaginal cross-arm piece, can be quickly changed to any position.

Occasionally, it is necessary to use the applicator to radiate the stump of a cervix when a supravaginal hysterectomy

has been previously performed. The cervical canal in such cases is usually about 2.5 cm. long. This is accomplished by placing a small collar-button end to the short uterine portion of the applicator.

The uterine portion of the applicator can be indefinitely prolonged by using additional uterine extension-sections of various lengths. This permits thorough radiation to the entire uterine canal regardless its length in the individual case.

The various portions of the uterine section of the applicator can also be used as applicators elsewhere in the body. By the use of a separate screw cap, it is possible to convert a uterine extension section and end into a separate capsule of variable size, thus virtually converting the applicator into one of universal applicability.

The most recent improvement has been the provision of a double vaginal-end to the applicator. This permits the use of two radium centers in the vagina instead of one, and is highly desirable when the vaginal vault is large and the applicator used in conjunction with a colpostat.

It is also convenient when the vaginal vault is small and it is impossible to use a colpostat in addition to the applicator.

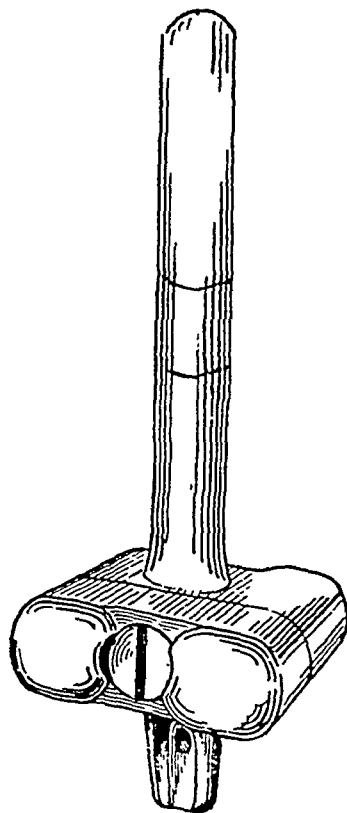


FIG. 9. Appearance of applicator with double vaginal end assembled for use in a uterine canal of average length.





# THE IMPORTANCE OF UROGRAPHY IN THE INTERPRETATION OF ABDOMINAL SYMPTOMS\*

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WITH an ever-increasing frequency, the profession in general makes use of the urologist in attempts to solve the extremely difficult problems in diagnosis which present themselves, but there are yet too many cases submitted to operation without the merciful aid of this illuminating branch of medicine.

Fortunately, many of our ideas of specialism are rapidly changing. For instance, we can all remember the time when it was thought a specialist was some one who knew at least one thing well. Sad to relate, even this was often not true. Today, a real specialist must have a thorough knowledge of the functions of every organ in the body, and then have a familiar knowledge of all known technic to correlate the information possibly attainable concerning some particular organ or system of organs. The urologist, for example, should be well grounded in all matters of general medicine; a competent anatomist; thoroughly conversant with the physiology of all organs; be especially keen in the interpretation of circulatory symptoms, and finally, be particularly familiar with all possible pathology of the abdomen and pelvis. With the aid of the advice of this type of urologist, the general or abdominal surgeon should bring his errors down to the very minimum. There are quite a generous percentage of this assembly, who were compelled to make all their diagnostic decisions before the days of the benevolent aids that are now offered by laboratory technic and highly developed specialism. To say that our surgery in those days was "all poor surgery," would be quite as far from the truth as to say that "all surgery of today

is good surgery." However, that it is now possible to have these aids, the burden of this discussion is an effort to arouse a determination to more frequently make use of them.

The present high prominence of urology, and especially urography, has been gained by constant and rapid progress. If I may be allowed the personal allusion, it has all occurred in the professional life of myself and therefore, during that of many of the audience.

It was only as far back as 1897, that Tuffier probably first suggested the combination of an opaque ureteral catheter and radiography. In 1906, occurred the first successful outline of the ureter and renal pelvis in the roentgenogram, which was made possible by the injection of colloidal silver; gradual improvements in technic followed, which finally resulted in the use of the salts of the halogen group, by Cameron in 1918. These have stood the test of service during the past decade, and it is during these past ten years only that urography has been made available to the profession in general.

Time will not permit a lengthy consideration of the contraindications to urography, but in passing, it should be urged that this work should be carried out by a thoroughly competent urologist and that the roentgenographic apparatus be located in the cystoscopic room that the roentgenogram may be taken without delay following the catheterization and injection.

The advantages derived from a more or less routine urography are not alone confined to the prevention of unnecessary surgery to organs not diseased, but apprises us of unsuspected pathology in the kidneys

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and ureters, which will very frequently permit us to successfully attack that pathology and prevent destruction of kidney tissue. Chute of Boston published in 1924, "An Analysis of Fifty Cases of Renal Calculi" showing the importance of early diagnosis and treatment of this condition. The principles he advocated are well worthy of our careful consideration, for which purpose I must simply refer you to his valued paper.

Pathology of the urinary tract may be confused with that of practically every abdominal organ, but there are a few organs which are especially liable to receive too much attention and treatment if urography is not properly used.

First comes the so-called cases of *chronic appendicitis*. The frequency with which a perfectly normal appendix is removed with no relief of symptoms has been appalling. This mistake has occurred in my own experience even after a thorough gastrointestinal study by a supposedly competent roentgenologist. A properly taken pyelogram would have prevented this error as it would in many instances that occur only too frequently.

*Acute Appendicitis*. At first thought it might seem most improbable that confusion concerning this disease should ever occur. However, it has frequently been diagnosed and operation completed upon a perfectly normal appendix.

*The gall bladder* is an exceedingly fertile field for unfriendly and unscientific treatment. A flat roentgenogram followed by urography will often disclose a stone or stones in the right kidney or ureter, or an hydronephrosis. On the other hand, the symptoms may point strongly to renal calculi, as they did in one of our very recent cases, but urography proved the urinary tract free from pathology which might cause the symptoms, and a further study revealed the stones to be in the gall bladder.

*Ptosis of kidney* can positively be diagnosed and may thus save the patient several unnecessary operations.

*Tumors of the right kidney* are at times diagnosed as lesions of the liver, when urography would speedily and surely



FIG. 1. Case 1. Calculus right mid-ureter.

"dispel the doubt and reveal the truth." With somewhat less frequency, difficulty of diagnosis is encountered with acute-diverticulitis, lesions of the pancreas, twisted pedicle of ovarian tumor, retroperitoneal sarcoma, and malignancy of the large intestine. A complete urological study, together with the use of the sigmoidoscope and general Roentgenograms, will reduce our mistakes to a minimum. To illustrate my contentions, I will cite a few cases that have been studied in our clinic during the past year.

CASE 1. W. S. a colored male, admitted August 30, 1926, complaining of pain in right iliac region, and a history of similar attacks for past seven years. One year previous to admission, his appendix had been removed but the same symptoms persisted. Physical examination practically negative except for some pain upon heavy percussion over right kidney. Urine negative. Leucocytes, 14,640 with 74 per cent polymorphonuclears. Blood urea 17 mg per 100 c.c. of blood. Wassermann negative. A plain roentgenogram showed a shadow opposite the fourth lumbar vertebrae on the right side. Cystoscopic examination revealed a normal bladder. A No. 4 flute catheter was passed up the right ureter and a pyelogram was made. This showed the shadow found on the flat roentgenogram to be included in the ureterogram, and a diagnosis of right ureteral calculus was made. The patient strongly desired operation rather than manipulation and an urgent necessity for his return

to work with the briefest period of morbidity being also present, a ureterolithotomy was done through a muscle splitting incision and

urged the importance of study before surgery. It was two months before she was able to leave her home and come to the clinic. An



FIG. 2. Case II. Extra-renal shadows, right.

the patient discharged in excellent health and spirits twenty-one days after the operation, and has remained in perfect health.

**CASE II.** Mrs. B., aged thirty-eight, first seen at her home, 50 miles in the country. Her chief complaint was pain in the right side extending from the chest to vulva, following the course of the right ureter. These attacks usually lasted from a few days to a few weeks. She had the first attack twenty-one years ago. Ten years ago, had a cholecystostomy, but no stones found in the gall bladder. Thought she had some little relief for two years, though the attacks continued. Two years after the cholecystostomy, the attacks began to increase in both frequency and severity and when seen this last January was incapacitated more than half the time. The patient described the attacks as coming on with a sort of tired feeling in upper right abdomen, this was followed by severe pain which radiated to the back and then down to the vulva. Sometimes, but not always, there was nausea, never vomiting. There was invariably frequency of micturition with distress while voiding, the intervals between micturition being only twenty minutes. The case seemed easily one of renal calculi, but we



FIG. 3. Case III. Calculous upper left ureter.

urinalysis and blood study were negative, and it should be noted especially that a Vandenberg was negative. The icterus index was 8. Cystoscopic and phthalein tests revealed nothing of importance.

A plain roentgenogram revealed two ovoid shadows in the region of the right kidney, but a pyelogram showed these to be extrarenal. A gall bladder series was then run and a diagnosis of cholecystitis with at least two stones was easily made. Operation proved the diagnosis to be correct, one of the stones having a prolongation that extended down the cystic duct for at least half an inch. A cholecystectomy without drainage was done, and the patient left the hospital in sixteen days, quite well, and reported April 20 that she had remained so and was doing her own work.

**CASE III.** Mrs. C. aged thirty-seven, admitted to the Clinic, February 1, 1928. Chief complaints were frequent micturition, pelvic cramps, pain in back. This latter symptom had been present since she was two years old, and followed a fall down stairs at that time.

Following the routine studies, a plain roentgenogram was made which revealed a shadow just below the pelvis of the left kidney. It also showed that the patient had six lumbar vertebrae and that the right transverse process of the first lumbar was fractured. A pyelogram was then made which showed the shadow to be within the ureter.

Diagnosis: Calculi in left ureter just below

the pelvis of the kidney. Operation proved this to be correct. A ureterolithotomy was done and the patient is doing well.

Examination was negative, except for diffuse lower abdominal tenderness. No masses were palpable. Examination of the urine was nega-



FIG. 4. Case VI. Extra-renal shadow, right. Double pelvis, left.



FIG. 5. Case VIII. Stricture of lower left ureter

CASE IV. Male, aged forty-five, referred for gastric surgery. Chief complaint was distress in region of stomach.

A gastric study revealed some gastric hypertrophy with probably some adhesions about the pylorus. A gall bladder series was then made and a diagnosis of cholecystitis with stones confirmed. A study of the blood and urine was without important findings.

Bilateral pyelograms revealed the right kidney to have a double pelvis with double ureter for a distance of six inches where they united into one. Both double ureters were markedly dilated. Diagnosis: Hypertrophied stomach, cholecystitis with stones, right double pelvis with partial double ureters.

The patient was advised to make an effort to get along without treatment.

CASE V. M. D., Female thirty-six years old. Was admitted to the hospital September 27, 1927, complaining of pain across her lower abdomen. Six and a half years ago the patient states that her appendix was removed for this same pain. The pain is diffuse throughout the abdomen without radiation, and is not accompanied by any urinary, gastrointestinal, or menstrual difficulties, with the exception of severe constipation.

A left salpingo-oophorectomy was performed and examination of the tissue revealed a small cyst and chronic salpingitis. Following operation the patient gained in weight, but continued to have some pain in the abdomen, frequency, and many pus cells in the urine.

Cystoscopy revealed a bladder wall, inflamed diffusely to a grade 1. Both ureters were catheterized and bilateral pyelograms made. These revealed a horse-shoe kidney with a moderate amount of dilatation of the pelvis.

CASE VI. Female, B. F., forty-seven years old. First examined October 28, 1927, complaining of severe pain in the left lumbar area radiating over the crest of the ilium. This pain has been present for about four days. During this time, she has had frequency and burning on urination. There is no history of hematuria or tenesmus. There have been no other symptoms of importance.

Cystoscopy showed the bladder wall to be diffusely inflamed. Grade 1. Both ureteral openings appeared normal and a clear spurt was seen from the right ureter and a cloudy spurt from the left ureter.

Examination of the urine revealed an occasional hyaline and granulated cast. Pus 1. Cultures from both kidneys were negative

and urea concentration was 0.2 per cent. A flat plate revealed a shadow in the upper right abdomen. A right pyelogram showed this



FIG. 6. Case ix. Stricture of lower left ureter.

shadow to be extrarenal. A pyelogram of the left kidney showed a complete reduplication of the kidney pelvis and a markedly enlarged kidney..

CASE VII. Female, C. W., thirty-six years old. First examined October 13, 1927, complaining of pain in the right upper abdomen. The patient gave a history of having suffered with pain in the right abdomen and back for over three years. The pain does not radiate to the right shoulder but has extended toward the vulva. There was some tenderness in the region of the gall bladder and the right kidney was palpable and tender. No history of jaundice or gastrointestinal symptoms. She had had duodenal intubations for drainage of her gall bladder within the last year with apparently little relief. There were no urinary or menstrual symptoms. Examination of the urine revealed numerous pus cells but was otherwise negative. The blood chemistry was normal.

Cystoscopy revealed a normal bladder. Both ureters were catheterized and a right pyelogram was made. The pyelogram revealed a ptosis of the right kidney with a hydronephrosis of a Grade 1. No infection was present at the time of examination as all cultures were negative.

CASE VIII. Male, F. P. thirty-four years old. First seen January 30, 1928 complaining of pain in the left lumbar region radiating

toward the umbilicus. This pain had been present for three years. There had been slight burning on urination. Physical examination revealed small left varicocele and slight tenderness in the region of the left kidney.

Cystoscopy was negative except for the fact that it was impossible to pass any catheters up the left ureteral opening. On a second cystoscopy, five days later, a No. 4 catheter was passed up the left ureter with some difficulty. This was withdrawn and the tip of a Garceau catheter was inserted in the left ureteral opening and a left pyelogram made. The pyelogram showed a stricture low down in the ureter near the bladder wall. The middle calyx is indistinct probably due to lack of filling, although tuberculosis should be considered. Guinea pig inoculation was carried out and the ureter dilated to a No. 9 French. Dilatations are to be carried higher as this treatment relieves patient's symptoms.

CASE IX. Male, E. S., forty-nine years old. First seen July 26, 1927 complaining of burning on urination and pain in region of the sacrum. A posterior resection of the rectum was done two years ago. Since operation, the patient has had burning and pain on urination frequently and tenesmus with nocturia of a Grade 4. He has also complained of chills and fever and pain in the left abdomen.

Examination revealed some tenderness in the left lumbar area and a draining sinus in the sacral region and a left rectal colostomy. On attempting to pass a standard size cystoscope, considerable scar tissue was encountered in the posterior urethra. This was dilated with sounds to a No. 26 French. The bladder wall showed a difused degree of inflammatory reaction. Urinary spurts were seen to issue from both ureteral meati, and a No. 5 catheter passed easily up the right ureter. It was impossible to pass any form of catheter for more than 4 cm. up the left ureter. A pyelogram revealed marked stricture of the left ureter.

CASE X. L. M. female aged thirty, first admitted to the hospital complaining of abdominal discomfort and pain over sacral region. She has been subjected to the following operations within the past few years: appendectomy, cholecystectomy, incisional hernia and tonsillectomy. In spite of the surgery the patient still complained as formerly. Her symptoms had always been indefinite, but

there had been continued pain in right upper abdomen and back, and pain in lower right abdomen. She has suffered of nausea and vomiting and her bowels had been constipated. A pyelogram of the right kidney performed Feb. 6, 1928, reported pelvis normal with ureter dilated. A short interval after this, her gall bladder was removed and was reported by the pathologist to be of the strawberry type, and there were no stones. Her examination March 16, 1928 was negative with the exception of some tenderness in both lumbar regions and a difused tenderness through the

abdomen. The patient impressed one as having a large psychoneurotic element.

Cystoscopy revealed a mild degree of inflammation of the bladder especially about each ureteral orifice. Bilateral pyelogram revealed a hydronephrosis of the right kidney of a Grade III with considerable dilatation and tortuosity of the right ureter. The left pyelogram was practically normal. Cultures of both kidneys showed a colon bacillus. This patient has undoubtedly had a progressive pyelonephritis of both kidneys, more especially on the right accounting for many of her indefinite pains,



# INFLAMMATION OF THE APPENDIX

## ITS INFLUENCE ON THE PELVIC ORGANS AND THE VERTEBRAL COLUMN (PAIN IN THE SMALL OF THE BACK, LUMBO-SACRAL SYNDROME)\*

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AS the following pages deal with the problem of pains in the small of the back (lumbago), it may be advisable to briefly indicate the meaning I attach to this term.

The general public frequently describe the whole region as far as the short ribs as the "small of the back," and in medical language the interpretation of the term is similarly vague.

I therefore wish to state that I only refer to those pains which are felt up to about the region of the ridges of the ilium and down to about the anal groove, whilst they may extend sideways about as far as the spot where the gluteal muscles connect with the hip bones.

The subject has occupied my attention for several decades.

In my larger work dealing with the part played by the nervus sympathicus in diseases of the appendix<sup>1</sup> I pointed out that patients suffering from diseases of the vermiform process often complain about pains in the small of the back and that a detailed examination of the rear portion of the abdominal wall and the back shows that the upper processes of the os sacrum are almost always subject to pain when exposed to pressure, and that the same remark applies also—though to a less extent—to the process of the fifth lumbar vertebra. This statement, however, was misleading; for in course of time it became evident to me (by means of x-ray) that it is precisely the spinous process of L.5 which is mainly subject to pain, whilst the same can only be said of the upper edge of the os sacrum in a more general and restricted way.

It is by no means easy to correctly determine the position of L.5 and its

process in the body of living persons; and so I trust that the mistake I made in looking for the L.5 process in too high a place will be considered pardonable.

Since then I have examined thousands and thousands of persons of both sexes, children as well as adults (in recent years mainly women) and I have over and over again found that my observation was correct. It is, indeed, a rare exception in connection with acute and chronic diseases of the appendix that the spinous process last referred to is not painful when exposed to pressure.

And always—almost without exception—my patients have stated that "it is there that the pain started."

According to their statements the pain radiates from there in both directions towards the region of the ridges of the ilium and also, frequently towards the righthand side only, beyond the ridge of the ilium into the region of the righthand groin and above Poupart's ligament.

If a careful examination is made by hand, it is found that the long dorsal muscles between the spinous processes and the ilium are painful. There one finds indurations and contractions of the kind already described by Cornelius, the latter being on the whole identical with the "geloses" described by Schade and with the "Hartspann" described by A. Müller-Gladbach.

The same observation is made in respect of the gluteal muscles, more particularly that part of them which is located below the ridges of the ilium and also that part located below the rear and upper spine of the ilium. In the case of elderly people it is not uncommon to discover fusiform indurations—for the most part in the

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plane of the lumbo-sacral connection—which may be exceedingly painful.

In a few cases I found some movable small glands close to the bone in the corners of the rhomboid fossa where not much adipose tissue has been developed. These are sometimes very painful, either on both sides or—less frequently—on one side only.

Erben is the only authority by whom anything similar is mentioned.<sup>2</sup>

Another spot sensitive to pressure—more especially in the case of sciatica and allied complaints—is located lower down, near the second point of intersection of a line divided into three parts and imagined to be drawn from the beginning of the anal groove to the trochanter major. It frequently happens that acute pains extending to the hinder part of the thigh and the outer part of the calf of the leg are produced by pressing that spot a little more firmly, such pressure being directed a little towards the interior. It is evident that, by doing so, the nerve trunks combined to form the large iliac nerve are pressed near the spot where they leave the pelvis and where they rest on the lower and hinder spine of the ilium.

If the palpation test is extended forward to the front part of the abdominal wall by way of the righthand ridge of the ilium (which is often very sensitive), the spots sensitive to pain which are characteristic of a diseased appendix may be discovered.

It should never be omitted to examine the patient whilst standing. In doing so, numerous tensions and indurations will be felt.

In a few cases I was able to ascertain the presence of a spindle resembling somewhat the stone of a date as regards its size and shape. It was almost as hard as a bone and was located near the forward and upper spine of the ilium and above Poupart's ligament.

If the patient is then made to double up her thighs and if the finger tips are inserted into the abdominal cavity (either

sideways or from above), it will be possible—provided that the patient is not too stout—to feel the ascending colon, the psoas and the curve of the vertebral column from the promontory upward about as far as the arches of the ribs. (It may be added in parenthesis that such palpation never causes any pain if the person examined is in normal health.)

The psoas is usually sensitive, either altogether or part of it. If the patient is made to lift her leg, the psoas is felt to become hard, and the sensitive spots become more painful than before. It is impossible to say whether the psoas itself, or the parietal part of the peritoneum, or the nerves located between the fibres of the muscle, or the ureter experience the painful sensation.

The large pelvis, too, must be palpated. If the finger tips are made to move back and forth on the colon so that it contracts, it will be found that, on its inner side and on the abutment of the large pelvis, the point of origin of the appendix is sensitive to pain.

In this connection it is necessary to bear in mind that the ureter is frequently affected in catarrhs of the right renal pelvis and that it is sensitive to pain.

Moreover, it often happens that the righthand side of the vertebral column up to its upper extremity is painful, either the whole of it or parts of it. The "κ" point, more especially, is conspicuous as a pressure spot located rather far down.

It is difficult to decide in each particular case whether the pain is located in the peritoneum, the mesenteric root, or the lymphatic glands and parts of the nervus sympathicus mixed up with it.

Radiations of the pain into the sensitive process of L.5, into the neighborhood of the stomach and the porta of the liver, and into the opposite side of the abdomen are likewise observed.

Very frequently pain is also caused by a deep-seated pressure on a spot just above the navel, when the finger tips reach the vertebral column. More than 20 years ago



I established a connection between this fact and the ganglion accumulations in that neighborhood, of which I showed at the same time that they must be sensitive to pain.

It is not the stomach which is the seat of the pain; because in the rare instances in which it is possible to palpate the "stomach fold" ("Magenstufe"), the latter is situated above the region where pain is felt. The pancreas cannot be concerned either; because it, too, is located higher. If the fingers move from this spot towards the left, pain is frequently caused near the sloping portion of the vertebrae, whilst there is less pain in the part lower down, towards the promontory. On the lefthand side, too, similar observations are occasionally made as on the righthand side—a fact which is presumably known to everyone engaged in such examinations. The circumstance that pain seated on the righthand side is sometimes also felt on the lefthand side, although to a less marked extent, may find its explanation in the principle of *allochiria*. Finally, it is necessary to examine the last of the lumbar vertebrae and parts at least of the entrance to the pelvis. The pain felt in the spinous process of L<sub>5</sub> originates in L<sub>5</sub> itself.

It is advisable to palpate the pelvic organs per rectum. The impression one is able to obtain in this way is far more accurate than that obtained through examination per vaginam.

In order to avoid tedious repetitions, I confine myself to stating that the results of this examination are in many instances identical with those reported by A. Müller-Gladbach. As a general rule, there is more pain on the righthand than on the lefthand side; but the results are subject to changes at different times.

It must also be borne in mind that the pelvic peritoneum (which reaches down to a considerable depth) and the numerous nerve elements cause a large part of the painful sensations felt in that region, and that the various uterine ligaments, the connective tissue enclosed by them, the

Fallopian tubes, the ovaries and the uterus itself are found in the most diversified conditions of swelling and displacement, more particularly so after repeated attacks of inflammation of the appendix.

I was much struck by an observation which I occasionally made when palpating the "bellies" of the *musculus pyriformis* which originate on both sides of the os sacrum.

This muscle was very sensitive to pain. The patient stated that she felt a violent pain, when it was lightly rubbed, on the thigh, just before the trochanter major; I made her abduct the right leg and caused her to draw it towards the resisting left hand. The muscle firmly contracted under the palpating finger, whilst at the same time a feeling of pain originated near the trochanter; probably at the spot where the muscle itself and its tendon join the bone. I feel disposed to look upon this phenomenon as something analogous to the pain felt in the knee which M. Lange<sup>3</sup> believes to be caused by a diseased condition of the *sartorius* muscle.

I wish to add that an observation of the back frequently discloses the presence of some large or small furuncular scars in (and above) the "small of the back" and (with particular clearness in the case of elderly patients) of a network of distended veins extending right across the sacro-lumbar connection, but decreasing in size in both directions. The number of furuncular scars is less in the front part of the abdomen; the venous networks are frequently irregular, and occasionally the right side of the abdomen protrudes further than the left.

These, briefly, are (more or less completely) the results at which I arrived after carefully examining a large number of patients suffering from chronic appendicitis.

Although this is not the place for elaborate discussion along the lines of differential diagnosis, it is nevertheless necessary to make brief reference to the close relations existing between the appendix

and the pelvic organs, in order to explain the connection between the latter and the type of pains dealt with in this article.

I still adhere to the conviction to which I gave expression more than 20 years ago, viz., that the relations between a diseased appendix and the organs of the body, including, of course, the pelvic organs, are mainly brought about through the intermediary of the vascular nerves.

It has been known for a number of years that inflammations of the appendix exercise a permanently injurious effect upon the pelvic organs.

The first consequences of blood congestion in the pelvic organs caused by way of the nervus sympathicus are increased menses and other menstrual discharges.

In the speculum an increased quantity of clear mucus may be seen as being discharged by the cervix (the so-called catarrh of the cervix uteri). In some instances the vault of the vagina is redder than usual—an unmistakable sign of an engorgement affecting also the pelvic organs located higher up. The whole may be described as a *colpitis fornicis*.

In addition to this, my observations have absolutely convinced me that engorgements of the pelvic organs originating from the appendix by way of the nervus sympathicus cause the entire ligamentous apparatus of the uterus to become relaxed, so that in many instances the movable dorsal position of the uterus is the result of repeated inflammations of the vermiform process.

This connection was first described by Edebohls.<sup>4</sup>

Dorsal positions of the uterus fixed by scars have been known for a long time past to be the result of appendicitis (Douglas exudation).

If, owing to repeated congestions, a certain inflammation of the pelvic organs has become more or less chronic, it frequently happens that they become subject to disease quite independently. The direct cause may consist in the unsuitability of the measures adopted at the time of

the menses, in abortions, or in similar circumstances.

Once such diseases occur, the part of the appendix concerned may also become painful, *although the organ itself may not be inflamed at all*. In like manner, there may be an increase in the pressure pain felt by the L.5 vertebra.

This painfulness and even the spontaneous pain felt in the region of the appendix are obviously due to reflex congestion of blood caused by way of the nervus sympathicus, or else it may be that some formerly inflamed region whose stimulus threshold is lower feels sympathetic pain.

In my opinion, the condition of the appendix during pregnancy provides sufficient proof of this statement.

It is exceedingly frequent during pregnancy, even during the first few weeks, that the vermiform process is painful to pressure although the persons concerned may be quite ignorant of it. If they make any complaints at all, they refer to some pressure in the region of the stomach. An examination shows that they usually mean the above mentioned pressure pain in the part above the navel; and if the matter is further investigated, it is found that all the signs pointing to a diseased appendix are present, including the sensibility to pressure of the process of L.5. The temperature often rises from 37.6° to 38.0° or even a little higher than that. At that time there can be no question of a displacement of the large intestine described by Füth.

This condition is of such frequent occurrence and is so characteristic that any troubles of pregnancy that may exist are certainly augmented by it and may be partly connected with it. I have already drawn attention to this subject in my earlier publication.

Similar phenomena, but of a much more violent nature, take place in connection with tubal pregnancies, and may lead to grave errors of judgment.

It is well-known that tubal pregnancy is often due to changes caused by inflammations of the appendix. If, under

these circumstances, the foetus breaks up or a tubal abortion takes place, the peritoneum experiences a very violent and painful irritation, which also causes the region of the appendix to become very painful, not only in response to pressure, but also spontaneously, no matter whether the tubal pregnancy is located on the right or left side.

In a few instances of this kind I observed that a lefthand tubal pregnancy, shortly after its breaking-up, caused violent pains in the right shoulder, although no blood clots were found under the diaphragm when the operation took place. In these cases the region of the appendix was very sensitive to pain. The process itself, as seen during the operation, had undergone some pathological changes, but there was no acute inflammation.

I have already pointed out in my earlier publication that pains in the shoulder are of no infrequent occurrence in inflammations of the appendix.

When the region of the appendix becomes painful through sympathetic peritoneal irritation, renewed irritation is caused to the original course (whichever it may be), in which the stimulus threshold is permanently located at a low level. This accounts for the pains felt in the shoulder in cases of tubal pregnancy.

It will be evident from the preceding explanations that in many cases a differential diagnosis between an inflammation of the ovaries and the Fallopian tubes (right or left)—which is often characterized by similar symptoms, although these are less violent—and an inflammation of the appendix is almost impossible, except perhaps after prolonged observation and prolonged treatment.

The insufficient knowledge and the incorrect interpretation of these matters account for many a sin of omission committed in connection with displacement operations and similar proceedings.

In all these cases the process of L.5 may also become painful, and some of the secondary phenomena referred to above may also be present.

In no instance, however, have I found this pain and this sensitiveness to pressure in connection with inflammations of the pelvic organs when the appendix was in sound health, and when the process of L.5 was insensitive to pressure. If the process of L.5 is not painful, the region of the appendix as a rule, is also insensitive.

The inference I draw from this circumstance is that the changes that lie at the root of the painfulness of the process of L.5 are not directly caused by an inflammation of the pelvic organs.

According to my experience and my investigations it is beyond doubt that in the case of patients visiting a gynecologist one of the most frequent causes of the group of phenomena here described—although, as we shall see later on, not the sole cause—is a diseased appendix.

The complaint here referred to is of a typically chronic nature. Generally speaking, women of advanced age are more persistently attacked by it than younger women or girls; and in their case the symptoms are also more complete in every way.

Before we proceed to give an answer to the question as to the pathologico-anatomical changes causing the phenomena here described—the lumbo-sacral syndrome,—it may be useful to briefly outline the general course of the basic disease, i.e., appendicitis, and its bearing on the phenomena here described.

In this connection it is absolutely necessary to call to mind the fact that, as is proved by pathologico-anatomical investigations, a diseased appendix is of exceedingly frequent occurrence. It must suffice to refer to two authors only. Aschoff<sup>5</sup> states that between 75 and 80 per cent of all persons between the ages of 50 and 60 suffer from a diseased appendix and that, at the age of about 40, only 1 out of every 3 persons has still a healthy vermiform process. In his latest publication on the subject, Aschoff points out that rudimentary acute irritations of the appendix occur far more frequently than is generally believed to be the case.<sup>6</sup>

Ribbert<sup>7</sup> states that "more than 50 per cent of all persons above the age of 60 suffer from obliteration processes of the appendix." It should be borne in mind that obliteration processes are regularly an indication of serious or frequently repeated inflammations.

Inflammations of the appendix originating in childhood are characterized not only by pains in the abdomen, but also by painfulness of the process of L.5 caused by pressure and—occasionally—by pains in the "small of the back." Rectal examination shows that the pelvic peritoneum is also painful.

My experience has shown me that the danger is especially great to young girls at the time of their first menstruation. The pains incurred at that age are often wrongly interpreted. They are looked upon as part of their puberty development or as being connected with their "growth;" and no particular attention is paid to them.

I feel pretty certain that acute inflammation of the appendix is particularly frequent during those years. This opinion of mine, like most of the experiences here described, was already recorded by me more than 20 years ago in the publication repeatedly referred to. H. Kümmell holds the same view.<sup>8</sup>

It should therefore be emphasized that any pains during the years of "development" and at the first appearance of the menses always indicate some pathological condition which it is our duty to elucidate and which is often due to a diseased appendix, apart from constitutional and other causes.

The acute inflammations of the appendix which are observable at the first appearance of the menses usually take place after the discharge of blood is over.

The week succeeding the completion of menstruation is the time during which acute appendicitis is incurred by young girls and women.

In the medical reports on older girls and women suffering from a diseased appendix we frequently find statements to the effect

that the menses were not accompanied by any pain during the first few years, but that the opposite remark holds good for subsequent years, this being due not only to nervous conditions generally, and to developmental disturbances, but also to repeated inflammations of the appendix.

This assumption is supported by the fact that the region of the appendix is not infrequently the seat of the dysmenorrhoeic pain.

The effect of pregnancy on an appendix that had been inflamed has already been discussed in the earlier part of this article. Additional injuries are sometimes incurred by such women at the time of their confinement.

We are therefore justified in stating that these patients have been suffering for a long time from a diseased appendix and that the effects resulting from this diseased condition continue to make themselves felt throughout the patients' life. It is easy to understand why this should be the case, inasmuch as the diseased organ is directly adjacent to the L.5 vertebra and its connections, which are therefore exposed to permanent or frequently recurring injuries of the kind described by O. Schäfer in two cases (*Gynäkologenkongress*, 1907). In both instances there was an incipient acute inflammation of the appendix as well as an oedema of the right ileo-sacral fossa, the abdominal walls and the right appendages.

Although I had been convinced for a number of years that the painfulness of L.5 (which is almost invariably encountered) must be caused by certain definite changes undergone by the vertebra, I never succeeded in ascertaining the nature of these changes, not even by the occasional recourse to x-rays.

Moreover, I was of the opinion that it is not only the vertebra itself which must have suffered some injury, but that the same also holds good for its articular connections, the networks of the *nervus sympathicus* covering it and adjoining it,

the connective tissue surrounding the nerves, the ligamentous apparatus, the interarticular cartilage connecting L.5 and

A short time ago Hans Albrecht published a detailed report on the importance of these joints and their pathological



FIG. 1.

the os sacrum, and perhaps also for the hard membrane of the spinal cord or for the spinal cord itself. The latter assumption seems to me to be borne out by the observation that, if pressure is applied to the process of L.5, the resulting pain is sometimes felt as far away as in the upper parts of the spinal column and in the back part of the neck, this being a well-known indication of what Hegar formerly called lumbar cord symptoms ("Lendenmarksymptome").

Of similar occurrence are injuries to the ileo-sacral joints and to their ligamentous apparatus accompanied by symptoms which to some extent are identical with or supplementary to those observed by me.

I wish to add that, on the whole, clear indications of diseased ileo-sacral joints were comparatively rarely ascertained by me.



FIG. 2.

changes<sup>9</sup> a report in which due attention is paid to the German and non-German literature on this subject.

Goljanitzki's paper entitled "*Die gewerblichen Erkrankungen des Kreuzbein-Lendenabschnitts und ihre chirurgische Behandlung*"<sup>10</sup> proved exceedingly useful to me in connection with the interpretation of the symptoms observed by me. Even though his investigations apply to persons engaged in heavy manual work who had suffered some accident, there is so much resemblance between his observations and my own that I have thought it indispensable to take recourse to x-rays of the cases investigated by me. The very first x-ray shows some special difference.

#### DISCUSSION OF ILLUSTRATIONS

In order, however, to effect a comparison, I first reproduce a view (Fig. 1) showing a normal lumbo-sacral connection, seen sideways.

Figure 1. The intervertebral cartilage between L.5 and the os sacrum is seen to be uniformly developed. The lower and hinder corner of L.5 coincides with the hinder corner of the os sacrum; and the lower front corner of L.5 does not extend beyond the os sacrum either.

Figure 2. This photograph was taken of an 18-year-old girl employed as an office clerk whose appendix had been removed was impossible to account for the increased temperature in any way. An examination of the genital organs per rectum showed



FIG. 3.

3 years previous, since which she had suffered pains in the back. She was pale and—owing to the pains—very run down and emaciated. On the sagittal photograph the upper arch of the os sacrum shows a gap into which the shadow of the process of L.5 protrudes. On the righthand side this process adjoins the os sacrum; but on the lefthand side there is a gap between the two bones.

A remarkable circumstance was that the patient did not suffer any pain when she bent her body to the right and that she did suffer pain when she bent it to the left. It is evident that the gap shown in the photograph left a sufficient space for play whenever she bent her body to the right. Patient's temperature was continually slightly in excess of the normal. She had been under treatment for her lungs for a considerable time past. Nothing abnormal, however, could be discovered; and it

nothing abnormal, except for some pain in the pelvic muscles. Patient was virgo intacta.

The side view did not come off very well and is not suitable for reproduction. Dr. Lorenz states that "the process of L.5 rises very steeply and it is adjacent to the os sacrum."

Goljanitzki reproduces one photograph which is almost identical with it (patient suffering from accident). He chiseled off the process of L.5 and ascertained that the os sacrum was so soft it could be abraded without any trouble.

Goljanitzki therefore treats it as a case of "osteitis dissecans" and thinks that the process of L.5 bored its way, as it were, into the os sacrum (accident). Seeing that this patient did not incur any kind of accident, we are probably concerned with a case of spina bifida. The process of L.5 grew into the gap and caused, of course, a consider-

able amount of pain, chiefly in the back and on the righthand side of the abdomen. Patient is one of those persons who assert

nearly down to the pelvis; characteristic skin folds.

Internal examination: Uterus same as



FIG 4A.



FIG 4B.

their discomforts have increased after the operation for appendicitis.

I suggested to patient that, following Goljanitzki's example, the process of L.5 should be removed; but she refused. I do not know what became of her; but I do not think that the pain can be eliminated in any other way.

Figure 3. Mrs. K., aged about 35. Three children. Diseased appendix, but not operated on. Complains of always feeling a pain in the small of the back. The photograph shows a typical "sliding" vertebra.

Figures 4a and 4b. Mrs. F., about 30 years old. Two children. Complained of violent pains during her last pregnancy three years ago. Menses failed twice; unbearable pain in the small of the back and lower down in the abdomen.

Examination showed that patient was somewhat emaciated. Inclination of pelvis very slight; costal arch had prolapsed

during second or third month of pregnancy; appendages and whole lining of small pelvis somewhat painful. Promontory just accessible, projected distinctly in a downward direction beyond interior surface of os sacrum, painful. No organic changes apart from those mentioned.

External examination: All the typical features of lumbo-sacral syndrome were very pronounced; lower parts of the appendix region distinctly painful.

Patient stated that she was suffering from appendicitis several years ago.

Diagnosis: Spondylolisthesis in addition to pregnancy and chronic appendicitis. Temperature slightly above normal.

Fig. 4a. The x-ray photograph (side view) clearly shows the type of an L.5 that had slid forward. Intervertebral disk not noticeable.

Fig. 4b. The front view shows that the shadow of L.5 projects beyond that of

the os sacrum like a segment. The vertebra has probably moved a little towards the left. Hence, the upper lumbar vertebrae have been twisted towards the right, as may be seen from the fact that their processes project very far in that direction. Pronounced lordosis of lumbar part of vertebral column.

It is impossible to be sure in this case whether the advanced spondylolisthesis was mainly due to appendicitis or pregnancy. Subsequent investigations must settle this point. It is certain, however, that the lumbo-sacral syndrome was very pronounced. Patient had a miscarriage and discontinued the treatment.

Figure 5a. B. O., aged about 35, seen early in April, 1928. Two children, again pregnant (second or third month). Very violent pains in the small back and abdomen. Healthy woman of good constitution.

External examination: The abdomen, which is somewhat protruding, can be made to recede considerably upon pressure. Vertebral column and adjacent parts on left side almost insensitive; but righthand side exceedingly sensitive to pain, more especially L.5 and promontory. Caecum above entrance to pelvis very sensitive on inner side; a slight pressure there causes pain to spread to back, where process of L.5 and upper ridge of os sacrum are very painful on pressure. The same applies to connecting parts of long dorsal muscles between ilium and vertebral column and to upper gluteal muscles.

Urine: nothing abnormal; other organs likewise.

Internal examination: Uterus pregnant in the second month, is located fairly deep and backward. Appendages and Douglas's pouch sensitive. No swellings anywhere. Temperature (rectum) at first fairly stationary between 37.3 and 38.1 for many weeks, subsequently receding in consequence of dieting and proper care of bowels. Pains in the small back increased during observation, which lasted several months.

The x-ray shows that the hinder corner

of upper surface of os sacrum opposite hinder corner of L.5 projects about  $\frac{1}{2}$  or 1 cm. too far forward, and that the intervertebral disk is narrow in that neighborhood, whilst it assumes a more or less cuneiform shape further in front. The space between the front corner of os sacrum and the corresponding part of L.5 is very large; but the frontal os sacrum does not project far beyond the front edge of L.5.

The process of L.5 is very wide. Its lower edge touches the upper edge of the first process of the os sacrum, which is also very well developed.

Figure 5b. A frontal view shows that there is sufficient room between the upper processes, but that the shadow of the process of the os sacrum touches that of L.5 and that the process of L.5 is curved towards the left and that it touches the process of the os sacrum without any intervening space.

Clinically, patient doubtless suffers from appendicitis during her pregnancy (fever and palpation tests). In addition, however, it may be surmised that the pain she feels in the back may be caused by the abnormal position of the os sacrum and the resulting friction of the two processes (cf. Goljanitzki). It was impossible for her to move backward. Any kind of movement caused her to be in pain, and there was no alleviation of it when she rested. Getting up in the mornings became a torture to her. Clinically, nothing abnormal was found in the ileo-sacral joints, although it might be suspected that the abnormal position of the os sacrum would lead to a wrong distribution of weight and that this would cause pain in these joints.

Patient declined to be operated for appendicitis, because I could not promise her that the pain in the back would disappear unless the process of the os sacrum were got rid off at the same time. Even then the result would not be certain, owing to patient being pregnant. Perhaps it might have been advisable to interrupt pregnancy at an earlier date. After a few months patient ceased to be treated by me.



Figure 6. Mrs. R., aged about 32, of slight, but even build. Normal weight 49 kilos. Resembles in her appearance a

the sensitiveness of the L.5 process remained; occasionally there was some fever, vomiting, etc., in the evenings. The opera-

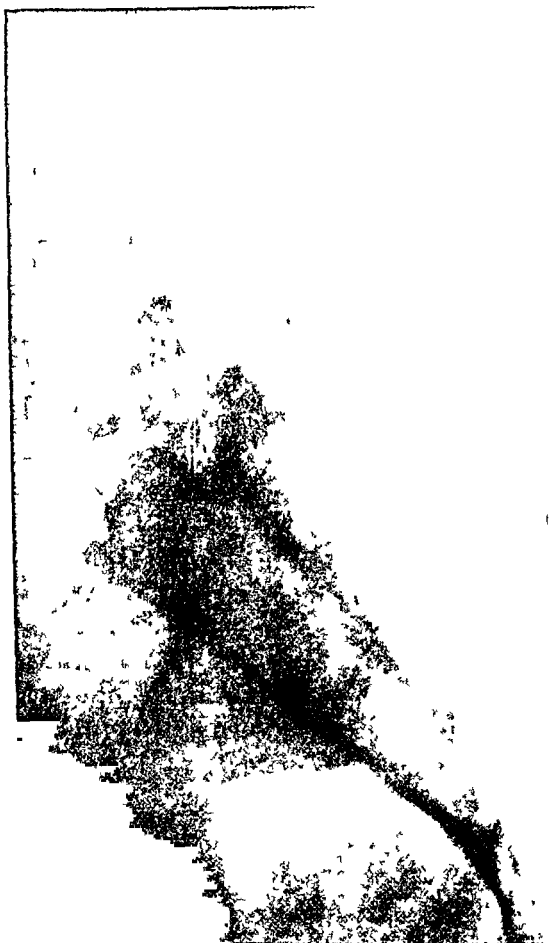


FIG. 5A.



FIG. 5B.

14-year-old girl, but has given birth to 2 fine children under normal conditions. Complains of pain in the back. For a time her temperature went up to about  $39.0^{\circ}$ . Two years ago, when treating her for a so-called catarrh of the cervix uteri, (unspecified), I told her that her appendix was diseased.

The examination disclosed, externally, all the symptoms typical of an inflamed vermiform process. Internally, however, nothing abnormal was discovered, except that the appendages on the right were slightly sensitive, without enabling any differentiation to be made. I suggested an operation. After fluctuations extending for weeks, the pain in the back disappeared;

tion disclosed that the vermiform process was 10 cm. long and that it protruded into the right pelvis. Behind a stenosis at the distal end there was some pus. No deformities. Since then all the trouble has come to an end.

The sagittal view shows that the L.5 process and that of the os sacrum are contiguous.

A side view shows that the upper os sacrum is narrow and rounded and that it adjoins the lower surface of the L.5 after the manner of a condyle. The os sacrum almost looks like an infantile formation.

Patient, when doing gymnastic exercises, could easily describe a complete curve

backwards. I feel convinced that she would considerably suffer from pain in the back if she had to do heavy physical work, such

more or less solid connection of a fibrous nature.

If we recall to mind the results arrived at

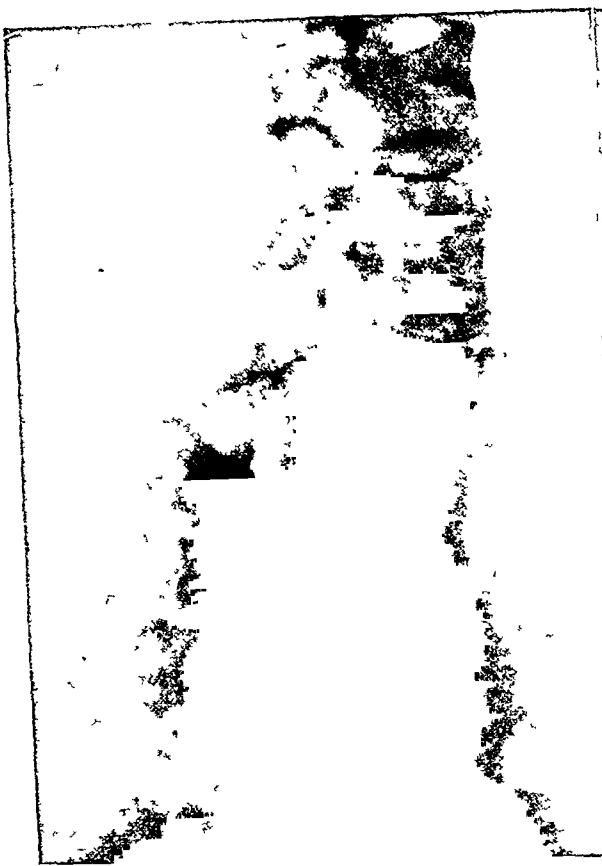


FIG. 6.



FIG. 7.

as carrying loads and lifting them. Her light weight is very helpful to her.

What, we may ask, is the relation between the above-described irregularities at the connection of the lumbar vertebrae and the os sacrum and the spondylolisthesis on the one hand and the inflammation of the vermiform process—which is or has been present in all these cases—on the other?

Is it possible that repeated inflammations of the appendix can cause the last of the lumbar vertebrae to “slide downward,” provided that the irregularity in the development of the centre of ossification in the interarticular part of the vertebral arch (described by F. L. Neugebauer) is present?

I wish to point out that this irregularity does not imply the ossification of the vertebral arch, but merely results in a

by O. Schafer (to which reference has been made above), more especially the oedematous saturation of the whole neighborhood of the appendix after an acute inflammation of the latter, we feel convinced that the neighboring parts of the vertebral column must also have undergone the same changes in all their constituent elements, more particularly those parts where the vertebral column is subjected to the heaviest loads and where every movement of the upper part of the body leaves its principal effects.

The inevitable result is that the weak part (i.e., the fibrous connection of the interarticular portion) becomes loosened. In like manner, the intervertebral disk (and the ligamentous apparatus)—although free from vascular organs—is bound to receive a large amount of infiltration from the outside margin and to

become softer. The necessary consequence will be that the last lumbar vertebra starts "sliding downward."

In my opinion the preceding argumentation and the inferences drawn therefrom are obligatory and do not admit of any counter-arguments.

The same remarks hold good whenever the L.5 vertebra starts "sliding" owing to one or more pregnancies, not to mention the additional load resting on it. *If both causes are present in combination, the results must be more pronounced still.*

If the irregular development to which the spondylolisthesis is due is not present, the os sacrum (Figs. 5a & 5b) owing to the loosening of the ligaments and the intervertebral disk—may itself start "sliding forward." I believe that this hypothesis explains the peculiar way in which the os sacrum is partly covered by the L.5 vertebra (*sacrolisthesis*).

I would like to emphasize that obstructions to and disturbances of the development may play a certain part in this connection. This assumption seems to be borne out by Figures 6 and 7.

These figures show that the upper surface of the os sacrum is rounded in a peculiar fashion. This may possibly be accounted for by assuming that the os sacrum was functionally "sliding" on the lower surface of L.5 for a considerable period of time.

These matters, however, will have to be further investigated and elucidated.

As far as I am concerned, I wish to state—with all the emphasis resulting from decades of experience and study of this subject—that I consider appendicitis to exercise a predominating influence on the origin of the lumbosacral syndrome.

The x-rays do not always visibly show the alterations that have taken place in the articulation of bones and joints.

When conditions are favorable, disturbances in the development need not by themselves lead to discomforts and pain.

My experience, however, has also shown me that repeated inflammations of the

appendix not only exercise the adverse effects upon the connection of the lumbar vertebrae and the os sacrum (already described), but that they may also lead to serious disturbances of the blood circulation (by way of the vascular nerves, *nervus sympathicus*) in the upper parts of the vertebral column. The nature of these disturbances has been disclosed by the careful investigations carried on by Ricker and his pupils. There can, moreover, be scarcely any doubt that Sudeck's bony atrophy is also among the resulting consequences.

It is therefore quite in harmony with the views put forward by Sudeck when I state it as my opinion that the lumbar section of the vertebral column may be subjected to a certain amount of atrophy due to some inflammation in any adjoining region (i.e., an inflammation of the vermiform process).

In the further course of development the lumbar part of the vertebral column, affected by the load on it and the muscular action concerned, is bound to suffer some sort of deformation which, in turn, causes secondary modifications to the thoracic part of the spine.

Hence, there are numerous cases of curvature of the vertebral column in which the deformation of its lumbar section must be regarded as primary.

The case illustrated by Figure 7 is such that, in view of the kind of the deformity and on considerations of anamnesis—it must be regarded as a primary kyphosis of the lumbar section of the spine due to an inflammation of the vermiform process.

Figure 7. J. M., a slim, pale-looking, delicate girl of 21. In her 12th year confined to bed for a long time owing to pains in the back and abdomen. Shortly afterward first menses. Two years ago operated for appendicitis. Kyphosis of lumbar part of vertebral column, the apex of it being located in L.1.

Employed as an office clerk.

The x-ray is reminiscent of Figure 6. Here, too, the os sacrum is conspicuous

for its small size. Its hinder corner is rounded and is not coincident with the hinder and lower corner of L.5. Nevertheless, the front corner of the os sacrum projects a little. Interarticular cartilage wide, cuneiform. L.5 appears to have become somewhat detached from L.4 and to have slid a little forward; and L.4 appears to be pivoted about its front edge a little towards the back edge, so that higher up kyphosis was bound to develop by way of equalizing.

Presumably there was an inflammation of the vermiform process at the age of 12, and this was followed up by the modifications of the spine.

These relations have been known to me for many years; because I observed more than once in the case of young girls after recovering from acute inflammations of the vermiform process that convex scoliosis of the lumbar section of the spine set in on the left side after the lapse of a certain period of time. This led me to believe that Sudeck's atrophy of neighboring parts of the spine was the indirect cause of it.

Several years ago I tried to convince the medical world that this belief of mine was correct; but I met with no success, because I had no x-rays for evidence.

Since then I have added further observations; and I am now more firmly convinced than ever that my interpretation of the facts is the right one. That these serious effects of an inflammation of the vermiform process upon the spine have remained unnoticed for so long a time, is presumably attributable to the fact that several months may elapse before the phenomena become manifest and to the further fact that these effects make themselves felt even if the inflammation of the appendix has not been of a very serious nature.

Since then I have seen that, after inflammations of the appendix which were clinically of a very harmless character, curvatures of the spine developed. It was only owing to the fact that my attention was constantly directed towards these

matters and that, accordingly, my eyes were open to see them, that I was able to appreciate the cause of these curvatures. I had trained myself to disclose the group of lumbosacral symptoms and to understand the causes to which they were due.

If it is thought unlikely that disorders which are clinically so harmless that they only lead to vague discomforts and that they do not even necessitate a rest in bed can cause such serious deformations of the vertebral column, it should be borne in mind that we are here concerned with youthful persons whose spine is still in process of growing and that its growth, owing to the abundant supply of the vertebrae with nerves and vessels, may be easily disturbed locally, e.g., by disturbances of the blood circulation after the manner of what Ricker<sup>11</sup> calls the "peristatic condition," which may possibly also be the cause of Sudeck's atrophy (perhaps after serious inflammations lasting a considerable time).

I wish to point out that, as early as about a quarter of a century ago, I showed that disturbances in the blood circulation—caused by the nerves of the blood vessels—often make themselves felt in parts located a long way distant from the source; but this is not the place to go into these details again.

Let us also remember that in all inflammations of the appendix the pre-vertebral ganglions (gangl. coeliac.) above the navel are invariably the seat of sensitiveness to pain, and often that of actual pain.

*All the elements contributing towards the formation of these ganglia, including the splanchnic nerves, are bound to become irritated.* As the splanchnic nerves, by way of the spinal cord, are connected with the ganglia of the funiculus marginalis of the middle part of the thoracic section of the vertebral column, they, in their turn, are bound to affect the vessels of the thoracic wall—including those of the vertebral column—which originate there.

Hence, it may happen that an acute inflammation of the appendix may lead

to disturbances in the blood circulation in the thoracic part of the vertebral column and that these disturbances may cause that part of the spine to become less rigid, so that it may become deformed and that a secondary curvature is the result. It is not difficult to imagine that such a combination of near and far effects may bring about the most diversified modifications in the structure of the vertebral column.

It stands to reason that individual vertebrae (intervertebral disks) may also become subject to such modifications. This must depend on the anatomical condition present in each case. *It is equally obvious that any kind of inflammation of a part immediately adjacent to the vertebral column (and not only inflammations of the vermiform process) may tend to bring about the same results, although I feel disposed to believe that inflammations of the vermiform process occupy a special position in this respect, this being due to the fact that the vermiform process is located so very close to that part of the vertebral column which is subjected to the heaviest strains and to the further fact that the pre-vertebral ganglia can always be proved to be in a state of irritation.*

In this connection I cannot refrain from directing attention to a paper written by my teacher Rüdinger which even now is well worth reading.<sup>12</sup> I quote the following passage from it: "I do not know any part of the animal body supplied

with as large a number of nerves as the various sections of the vertebral canal." I wish to add that the supply of blood vessels is equally abundant.

By advancing the views outlined in this article I continue to proceed along the road which, almost 25 years ago, I started independently and from which I have no reason to deviate now, more particularly now since Ricker published the comprehensive and detailed results of his investigations (however keenly these may be converted) and—quite recently—since E. F. Müller, although proceeding by quite different methods, arrived at very much the same conclusions as I.<sup>13</sup>

It is certainly absolutely necessary that these matters should be carefully examined by others, not only because of their great practical importance or for the reason that they are indubitably connected with pathological and physiological processes that cannot be contradicted, but also because their investigation implies the application of new methods to the scientific problems with which we have to deal.

I hope to be able soon to publish a separate paper devoted to the conclusions to be drawn from the preceding material.

The x-rays originated partly in the laboratory of the Hamburg Sick Insurance Society (Dr. Lohfeld) and partly in the Institute conducted by Professor Holthusen and Dr. Lorenz. I desire to sincerely thank these gentlemen for the loan of the photographs.

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## EDITORIALS

### AN INQUIRY INTO THE CASE FOR CHRONIC APPENDICITIS

ACUTE appendicitis is a surgical disease, the remedy for which is prompt operation, and the fact that it still exhibits an appalling mortality is a reflection upon our performance, or rather upon our delay in performance, not upon our therapeutics. The status of chronic appendicitis, however, is quite different. Surgeons and pathologists of equal skill and experience argue with considerable acerbity for and against its very existence, though the majority of surgeons continue to operate for it. The laity, almost in the same breath, demand that their appendices be removed and rail against the profession for taking them at their word and performing unnecessary surgery upon them. The result is hopeless confusion of thought

and action, and it is with the idea of clarifying in some small degree a subject so obviously in need of elucidation that I am venturing to ask you to consider with me a theme which some may think has already been considered too often.

Acute appendicitis is an established clinical entity; of that there can be no doubt. Likewise there can be no doubt that there is a type of appendiceal disease characterized by repeated acute exacerbations of more or less severity, from which the patient recovers and in which there can be elicited all or part of the syndrome of the acute disease. The patients who have passed through attacks of this kind and who, thanks to a skilled physician or a beneficent Providence or both, as

you will, have not perished in them, frequently have some residual evidence of the experience they have undergone. In some instances (I quote freely from Hertzler, whose masterly article on this subject anticipates all that I shall try to say to you) there is practically a complete return to normal. If only the fixed tissue cells are irritated, the exudate is quickly absorbed and restoration quickly occurs. A moderate degree of polynuclear infiltration may regress and leave no obvious changes. But parenchymatous tissue, once actually destroyed, is not replaced in kind, and some degree of scarring is bound to result. Indeed, the process may go on to total destruction of the organ and, if the patient survives, which is not the usual outcome of the untreated case, only the mesoappendix may be left as an evidence of what has occurred. But a scarred appendix is not necessarily the seat of present symptoms, and the changes we have described are evidence of past disease. They do not represent a continuing process. They represent a process which has occurred, which may occur again and which warrants surgery as a prophylactic measure because of that possibility. The correct nomenclature, however, for such a condition as this is recurrent or relapsing appendicitis. It is not chronic appendicitis.

With the conception of appendicitis as a recurrent or relapsing disease there can be no basis of quarrel. Diagnosis is self-evident, surgery has a logical foundation and end-results are excellent. The error is that we are thinking loosely and speaking with corresponding looseness. Hertzler is not the only one who has pointed out that the term chronic, as applied to a process extending over a period of time, is sensible speech, whereas the term applied to a degree of inflammatory reaction makes no sense at all. I plead guilty to this sort of slovenliness myself. I have no doubt that within the week I shall emerge from the operating room and request the stenographer to

put me on record as having removed a chronic appendix, when in reality I mean that I have removed an appendix which has been the site of inflammation in the past and which I fear may give rise to trouble in the future. Most of us, I think, are honorable in our endeavors and reasonably lucid in our ratiocinations. But we are also inclined to carelessness in the expression of our thoughts and our performances.

There is another type of appendicitis, however, which has no such definite etiology. It is the type manifested primarily by pain in the right iliac fossa, secondarily by vague digestive disturbances, the so-called appendiceal dyspepsia. It is the type of appendicitis which is the happy hunting ground of the occasional operator, and which is the despair of earnest clinical surgeons and equally earnest pathologists. For its mere existence is open to decided doubt. Conscience may make cowards of us all, but that sort of chronic appendicitis seems to make cynics of us all. Hertzler, who came up through the laboratory, puts it rather neatly. Who wants, he says, to report an appendix negative when the chief of the department of surgery has removed it on the ground that it shows chronic changes? The pathologist knows what he is supposed to find in such circumstances: either the changes in question or a new job.

The poor pathologist, as a matter of fact, is rather to be pitied. He does not know, any more than you or I know, what constitutes a normal appendix. One authority makes size, contour and location his norm. Another has an elaborate set of specifications as to histology. A third takes as his standard the appendix in infants from four to twelve months, which seems rather hard on the vast majority of adults, who certainly cannot be expected to exhibit that variety. Williams and Slater echo the experiences of dozens of others when they report that of 500 appendices removed routinely

in the course of operation for other conditions, and in no instance giving rise to demonstrable symptoms, one-third showed evidence of the changes usually reported from the laboratory as due to chronic inflammation. I think it is Deaver who says that it is rare for an adult to possess an appendix normal in every respect. If that is true and if it proves anything, it would seem to prove that abnormalities of gross appearance are not necessarily pathological. We are rapidly becoming a people without tonsils. Does Deaver's statement herald the day when we shall be a people without appendices also?

To return to the clinical picture of this second, non-recurrent type of appendicitis, improperly described as chronic, its symptoms are as vague as the disease they are supposed to arise from. They usually start with pain in the right iliac fossa, though a study of the anatomy and nerve supply of this region should be sufficient to assure us that disease in the appendix does not primarily so manifest itself. They include vague gastric symptoms and even gastric hemorrhage, a contention for which Lord Moynihan is largely responsible and which surgeons who lack his discerning judgment and his technical skill have turned to evil account. They comprehend such far-fetched manifestations as colitis, arthritis, neuritis (focal infection is still the god of many) menstrual irregularities, nervous disturbances, melancholia, inability to think clearly, and even angina pectoris. Hertzler has collected most of this sorry list and I am inclined to agree with him in his caustic comment that when he has contemplated it, he becomes afflicted with all the symptoms himself.

The diagnosis of this type of appendicular disease is an unsatisfactory affair. Literally a dozen conditions must be differentiated from it, ranging from simple constipation to intercostal neuralgia. Royster lists 14 different signs, advanced by 14 different people, all of them an-

nounced by their authors as definitely diagnostic, and most of them having to do with the location of pain or tenderness at a fixed point or as a special reflex. Hausmann may have been the first to express it, but he was not the first to realize that a fixed point on the abdominal wall can never correspond to an inconstant point within the abdominal cavity like the insertion of the appendix. It seems to me, too, that an intra-abdominal disease which must be eliminated by such remote methods as an investigation of the sinuses, the eyes and the sacroiliac joint, though I am far from denying the interrelation of all bodily parts, has a hard case to prove.

The laboratory in general, the x-ray laboratory in particular, frequently mean nothing but an added expense for the patient. Both the absent and the visualized appendix are variously supposed to indicate pathology. Carman, than whom no more practical radiologist ever lived, pointed out that every single x-ray finding, even the pressure-tender point accepted as infallible by most of his brethren, can be discounted in some way. In his opinion the exclusion of pathology in the stomach and duodenum is the most valuable service the x-ray can perform in this connection, and he adds—it is queer how everyone tends to cynicism in the discussion of chronic appendicitis—that the x-ray signs of it depend largely upon the examiner's intensity of endeavor and degree of enthusiasm.

For my own part, I would bid you beware of the acceptance of pylorospasm as a sign of anything. I can recall offhand a dozen people who today, as least as far as I am concerned, would be without their appendices had I been led into surgery by this sign and the insistence which the radiologist placed upon it. Most of these patients, by the way, had diagnosed their own disease. They had appendicitis on their minds if not within their abdomens and they furnish one of my reasons for wondering, in moments



of discontent, whether we may not be teaching the laity too much about the diseases to which humankind is liable.

Again, there is a difference of opinion as to whether this so-called chronic appendicitis predisposes one to acute appendicitis. One writer seriously suggests that possibly the reason for the increased death rate in acute appendicitis, which is most regrettably the present situation in that disease, is that we are performing fewer operations for chronic appendicitis. That may be his experience, but most of us do not live in such favored localities. Royster states that those cases of acute appendicitis in which the pathologic findings are out of all proportion to the duration of the disease are evidences of an acute exacerbation of long-continued chronic changes. Personally, I find it simpler to consider them illustrations of fulminating pathology. Many pathologists, as a matter of fact, believe that the acute exacerbations of recurrent appendicitis actually cause milder pathologic changes than does the single clinical explosion of the true acute disease, though others take the opposite view. At any rate, the point is open to argument on both sides.

I have been impressed, in a casual reading of the literature, with the fact that most of the writers on the subject of chronic appendicitis, except the iconoclastic Hertzler, seem to be on the defensive. They have a case to prove, and be it conceded that most of them make out a good one. But one thing strikes me as very curious. Granting that persons with pain in the right iliac fossa and vague digestive disturbances should be treated by appendectomy and that benefit sometimes follows; granting that chronic appendicitis does exist as a clinical entity; granting that Deaver and Moynihan are right, granting that Hertzler and Walton are wrong (for the opponents and proponents include such illustrious names as these); granting all of this and a good deal more, why, if these things are so and if

chronic appendicitis is a definite affection of the appendix, why in the world is it necessary in so many instances to seek an extra-appendicular explanation for it?

I have very little patience with the mechanical explanations of chronic appendicitis. I am perfectly willing to grant that most annoying and distressing symptoms may arise from interference with cecal peristalsis, from bands, adhesions, stasis, colitis, duodenal atony, reduplication of the peritoneum and other mechanical abnormalities. I am perfectly willing to agree with the writers who claim that in the presence of such associated conditions mere appendectomy will not give relief, and that other procedures, some medical, some surgical, are indicated also. But why then term the condition chronic appendicitis? Carnett and Boles, in a very excellent paper, advance the theory that chronic appendicitis is not a disease limited to the appendix but is a more or less generalized condition involving the colon and other portions of the gastrointestinal tract, as well as the sensory nerves of the abdominal wall, and seen most frequently in constitutionally inferior types with a predisposition to functional disease. All of which is quite true. No one is readier to admit than I that such a syndrome can give rise to a great deal of trouble. But why call the disease chronic appendicitis and then point out that the appendix really has little if anything to do with the condition?

In short, let us do a little clear thinking. Let us admit that acute appendicitis exists. Let us admit that recurrent appendicitis exists. But let us admit also that it is most unreasonable to lump together a miscellaneous group of symptoms, extra-appendicular, mechanical and constitutional, and call the medley chronic appendicitis, when the syndrome has no relation at all to disease in the appendix as we know it exists.

The test of the correctness of diagnosis and treatment in any disease is the end-result, from the viewpoint of the patient.

But it does not follow that experimental appendectomy is justified because in some cases it relieves symptoms. Other things must be considered, the period of disability, the cost to the patient in dollars and cents, and the actual risk to life. Appendectomy is not an operation entirely devoid of risk. Warnshuis collected 5664 surgical cases of chronic appendicitis from 35 hospitals, and found a mortality of 1.68 per cent. It ranged from 0 on single services in some institutions to 2 and 3 per cent in others. The mortality in nearly 10,000 cases done at Charity Hospital and Touro Infirmary in New Orleans over a six-year period was considerably less than 1 per cent. Yet in these supposedly clean, uncomplicated cases the causes of death included peritonitis, sepsis, obstruction, shock, embolus, secondary hemorrhage and organic disease. A list like that offers reasons for earnest thought. It includes some preventable surgical causes, some unavoidable accidents, both of which may come to pass in the best hands, though not so often as in less good hands. For we must remember, as I have already pointed out, that because appendicitis is supposed to be a simple disease and appendectomy a simple operation, the occasional surgeon gets in his deadliest work in this field. That is more than an impression; it has been proved statistically.

Granting, however, that the patient emerges with his life, as he does in the vast majority of cases, what happens then? Well, according to published figures, he has a 15 to 50 per cent chance of receiving no benefit at all. Many patients are considerably worse, especially the neurotic patient, with whom a simple appendectomy is often the starting point for as many abdominal operations as she (it is usually a she) has organs to be removed, after which there can always be laparotomies for adhesions. But the thing that interests me in the series reported by Deaver and Ravdin, by Holder and Menninger, by Gibson and many others, is that the great majority of all the patients gave a history

of previous acute attacks. That is the catch in every such series, or rather, to put it more correctly, that is the rational explanation of successful surgery. This is appendicitis of the recurrent type, for which surgery is indicated and in which surgery is justified, and it has nothing to do with the vague disease we are endeavoring to put in its place.

I am far from denying that abdominal and constitutional symptoms frequently urgently demand operation; but my point is that we should do away with the diagnosis of chronic appendicitis, which means nothing, and frankly set ourselves down for exploratory laparotomy, which may mean anything. Then, having been lucid mentally, let us make our actions correspondingly logical and let us do our exploration through a proper incision. The McBurney incision in chronic appendicitis is the curse of surgery. My own opinion is that it is indicated only in 1 group of patients, boys under sixteen, in whom it might be preferable to do a secondary operation rather than to weaken the abdominal muscles. I shall not enter upon the vexed and highly speculative question of whether the appendix is a predisposing factor in lesions of the upper abdomen; I am simply pointing out that appendiceal disease of the non-recurrent type is often associated with lesions of the gall-bladder and of the gastric area. A third of the patients who consult me for these latter conditions, in both of which, as in appendicitis, pylorospasm is a marked feature, give a history of previous appendectomy, in 9 out of 10 cases through a McBurney incision. Within the month I have operated on a young woman for duodenal ulcer and gallstones who, less than a year ago, had her appendix removed through a McBurney incision for precisely the same symptoms which I hope my recent performance is going to rectify. I have seen chronic appendicitis handled through a McBurney incision develop into ureteral calculus, ureteral stricture, floating kidney, ectopic gall-

bladder, cecal diverticula, tubal and ovarian pathology, and biliary and gastric lesions. Even more tragically, I have operated on patients with hopeless malignancy of the upper abdomen who had had a so-called chronic appendix removed through a McBurney incision.

I grant all that can be said in its favor, the speed with which the operation can be concluded, the absence of shock from exposure of the internal viscera, the swiftness of recovery, the inconspicuousness of the scar. But under the conditions of civilized life and customs I have never felt that the last argument was a very valid one, and against the first arguments I would advance two others. One is that the appendix does not always lie ready to hand, in which case there is nothing swift or smooth about one's performance. I have recently removed an appendix which lay under the liver and was adherent to the duodenum, and my task was none too easy through a right rectus incision of generous proportions. The second is that the McBurney incision does not permit the complete inventory which should be a part of any abdominal operation in which special contraindications do not exist, and which should never be omitted in any instance in which laparotomy is done for supposed chronic appendicitis.

Mr. Walton of the London Hospital has had as wide an experience in abdominal surgery as any man living. He has recently reported 982 cases of appendicitis, 722 of them acute, and in the remaining 360 all but 11 patients having had at least 1 acute attack. He has done 1738 operations for upper abdominal lesions, and although it is his custom routinely to remove the appendix if it is grossly pathologic, he found appendectomy necessary in just 4 per cent of these cases. His follow-up is excellent; I have personally seen it in

operation and I can testify to its effectiveness. Yet in spite of the part the appendix is supposed to play in gastrojejunal ulceration, less than 2 per cent of the patients operated on for peptic ulcer returned with this complication, and only .28 per cent of the whole group later developed acute appendicitis; their risk was far less, I am sure, than it would have been with the routine performance of appendectomy.

In the face of figures such as these, published from such an authoritative source, I believe the case for chronic appendicitis of the non-recurrent type cannot stand. For my own part, I accept them unreservedly and I hereby announce that I have joined the ranks of the cynics. I may not quite agree with the wit who put appendicitis into 2 classes, the acute variety and the variety for revenue only. But I am wholly one with the eminent medical gentleman who, when questioned concerning the function of the appendix, replied in all seriousness that it contributed largely to the support of a noble profession.

URBAN MAES, M.D., F.A.C.S.

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## WHY A HOSPITAL DEPARTMENT OF RADIOLOGY AND WHENCE THE RADIOLOGIST?

THE radiological department of a hospital should not only furnish appropriate assistance in the routine examination and therapeutic management of patients, but should make important contributions to the staff conferences, assist in the instruction of internes and the other members of the staff concerning the application of radiology to the problems of diagnostics and therapy, including the possibilities as well as the limitations of the roentgen ray aid, and help in various research problems as they present themselves. Incidentally it should be remarked that the hospital management should not look upon the radiological department as a profitable investment, and it should not be considered a duty of the department to contribute to the financial upkeep of the institution until all the foregoing objects have been achieved. There is no more justification for the hospital to capitalize the experience and services of the physician specializing in radiology, than to put the operating room on a fixed-fee basis, pay the surgeons and nurses salaries, and credit the profits to the income of the hospital.

In order to meet the foregoing aims the department personnel must include a physician-radiologist. It is difficult to understand the attitude of some hospitals where the staff is apparently willing to delegate the management of the radiological examinations and their interpretations to laymen doing radiology. The writer recently saw a formal written report of several examinations, including a Graham test and a gastrointestinal study after the opaque meal and an enema, ending with an opinion as to the existence of several pathological conditions, signed by a layman doing radiology. The patient had been referred to this layman by a physician!

In order to attract men of broad capabilities to the field of medical radiology

the medical profession as a whole should recognize its duty in regard to lay radiologists and stop to consider what should be its attitude toward the hospital radiological department. For the good of the service this department must not become a photographic center for the production of pictures to be interpreted by the various surgeons, internists or specialists who may have ordered the x-ray studies. There is a growing tendency to look upon the x-ray department as just this type of photographic laboratory, the roentgenograms being sent to the ward or office where the original referring physician often appears willing to make his own readings and seems perfectly content to assume full responsibility for the radiological diagnosis. We should look ahead to see where such a practice leads.

Does it mean that the chest films are to be sent to the department of pulmonary diseases, the gastrointestinal films to the gastroenterological department, the head films to the neurological department, etc.? If so, what about the fluoroscopic examinations? What future can be seen for the radiological department other than as a photographic laboratory, and what need for an experienced physician-radiologist in such a place? Such a development would mean setting back many years the clock of radiological progress, for it would mean the abandonment of all help obtainable from screen studies by a medical radiologist with his accumulated experience of many years in examining patients from all departments of a hospital, to say nothing of his private practice.

We do not wish to intimate that an internist or other specialist has not a perfect right to fit himself in every possible way for the practice of his specialty; and if he wishes to utilize the roentgen rays as one of the methods of study, there can be no logical objection raised to his use of this procedure. It is his need to see that

he has had sufficient training under expert tutelage for the radiological work. But if the hospital should be so unwise as to divide up its radiological work, apportioning it out to various departments, there would be lost that great help to physicians, surgeons and radiologists which comes from frank discussion of the roentgen findings between radiological specialist and referring physician, and their proper evaluation in the light of the clinical aspects of the case which such discussion naturally and inevitably brings out.

The roentgen report should contain only statements which can be substantiated from radiological evidence. This report will then take its place with the other evidence of the case, from which the clinician in charge will draw his conclu-

sions; but if the staff members have the slightest interest in the development of a capable radiologist whose usefulness will continue to enlarge, they will leave no stone unturned to keep him posted in regard to his cases, tell him of his successes as well as his failures and send for him when the surgeon or pathologist has let the light of day upon a lesion which has been baffling. Thus not only will he be likely to become a more skillful radiologist but he will surely broaden out into a better and more useful consultant. With such an interesting future in prospect for the radiologist, there will be no difficulty in attracting from the ranks of experienced clinicians capable physicians willing to devote themselves to the specialty of clinical radiology. JAMES T. CASE.



## REPORT OF THE RECENT JOINT MEETING OF THE BRITISH & AMERICAN ORTHOPEDIC ASSOCIATIONS\*

THE credit for the trip of the American Orthopedic Association to Europe belongs entirely to Dr. Albee. One of his first suggestions as president-elect was that we should go to England for a joint meeting with our British colleagues. The officials of the British Orthopedic Association were favorably disposed toward the proposal of a joint convention. The idea took root and the meeting was officially authorized a year ago in Washington.

The preparations for the meeting were then undertaken under the supervision of the Executive Committee of the American Orthopedic Association. Dr. Ellis Jones, of Los Angeles, the Chairman of the Program Committee, requested me to arrange a clinical program to be presented in New York. This is ordinarily given in one day. However, because of the long journey ahead of us, and because many of the members who could not go

abroad would gladly attend a meeting in New York, I decided to extend the clinical session to two days. It seemed desirable to cover a large variety of subjects and to let the work of each man represent that in which he excelled. Consequently I arranged a series of operative clinics for the first day. Each surgeon prepared to perform those operations in which he was specially interested. In addition there were sarcoma and arthritis clinics. On the second day all the presentations were, as a matter of convenience to the visitors, made at the Hospital for Ruptured and Crippled. These included, besides strictly orthopedic cases, related bacteriological, pediatric and neurosurgical subjects. The clinical meeting was attended by more than 200 surgeons. The visiting surgeons commented very favorably upon the program, and expressed the opinion that they had profited by their attendance.

Up to five years ago the annual orthope-

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dic meetings began at 9 A.M. the first day and terminated abruptly at 5 P.M. the last day. As there was no relaxation from the cold, strictly scientific program during the entire convention, attendance sometimes became an ordeal. About five years ago, when the meeting was to take place in Baltimore, Dr. George Bennett arranged that the convention be held on board a steamer sailing down Chesapeake Bay, and the members' wives were invited to accompany them. This introduced a custom which has contributed greatly toward the pleasure of the annual meetings, and has converted what used to be a mere scientific obligation into a much-sought-for vacation. Accordingly, as there were many ladies going abroad with us this year, appropriate entertainment was provided for them in this city on the day before sailing. The necessary funds were generously donated by the orthopedic surgeons of our city. The details were looked after by Mrs. Armitage Whitman, Mrs. Kleinberg and several others. The visiting ladies were taken to various interesting parts of our city. In the evening we were all the guests of Dr. and Mrs. Albee at a very delightful banquet in the Commodore Hotel.

Our voyage across the Atlantic was nothing short of delightful.

After a restful voyage of nine days we arrived in Glasgow.

After crossing Loch Lomond, we were taken by old fashioned stage-coaches to Loch Katrine. Our coachman was of the traditional type described so well by Washington Irving in the Sketch Book. He wore a bright red coat and a broad rimmed low derby set at a slight angle. He was stout and had a ruddy plethoric complexion. His mien was very serious and he held his station on the box with becoming gravity and dignity. Each coach had what looked like a frail body mounted on thin wheels.

On the following day we were taken by special train from Edinburgh to Liverpool, Liverpool which to us means Sir Robert Jones, that charming, genial, wonderful

man. He was our host at dinner that night. Months previously he had requested me to extend an invitation to everybody in our party, men and women, members of the American Orthopedic Association and all other visiting surgeons, to be his guests. His hospitality and warm welcome will forever remain with us as a beautiful memory. To be interested in orthopedic surgery is a passport to Sir Robert's friendship. We were with him almost continuously for four days. His depth of information, his skillful hands, his wise and liberal counsel, his tireless energy and his ever kindly and warm smile, alike for everybody, form memories that will serve to make of us better orthopedic surgeons and better men.

On the next day, July the third, there was a scientific program which lasted from 9.30 in the morning until 6 o'clock in the afternoon. The meeting in the morning was held in the "Medical Institution" of Liverpool, which is, I take it, the equivalent of our Academy of Medicine. Sir Robert Jones read a paper on "Fractures and Bone Setting" giving us many points of very great value in connection with the treatment of fractures and injuries in the vicinity of the joints of the upper and lower limbs. He stressed the importance of the position of abduction in the therapy of shoulder disabilities. He described lucidly and demonstrated his method of reducing dislocated semilunar cartilages. He practically makes the patient reduce the dislocation. The procedure is as follows: The limb is flexed and as the surgeon rotates the leg inward, the patient is instructed to kick violently. In this act the cartilage usually slips back into place. Sir Robert also showed us the most practical manner of reducing a Colles' fracture, and indicated that the best attitude for subsequent immobilization is that of palmar flexion and ulnar deviation of the hand. He also demonstrated the use of malleable iron splints. He spent considerable time on the subject of parietal adhesions. According to Sir Robert a joint that has periarth-

ritic adhesions should in a so-called stretching be moved once to the fullest extent in all directions and then left alone. Repeated, forced and painful movements irritate and should be avoided.

Mr. MacFarland, one of Sir Robert's junior assistants read a paper on "Fracture of Lower Tibial Epiphysis," and Mr. Watson Jones, discussed the "Primary nerve Lesions in Injuries of Wrist and Elbow." Both papers presented excellent reviews of these subjects and were beautifully illustrated with original drawings and lantern slides. Mr. MacFarland laid great emphasis on the need of so reducing the fragments in a fracture that the articular surfaces will have normal alignment. This will assure the best functional result.

In the early part of the afternoon there was a surgical clinic, and both Sir Robert and his Senior Associate, Mr. MacMurray operated. Sir Robert did an osteotomy of the tibia and fibula for old malunited Pott's fracture, obtaining a complete correction. Mr. MacMurray removed a loose internal semilunar cartilage through a vertical incision that was no more than  $1\frac{1}{2}$  in. long. The operation was performed very rapidly and most dexterously. Hardly before we realized it the cartilage had been delivered and removed. The technique was carried out with ease, grace, the minimum of trauma and the maximum of efficiency. Using a small incision it was necessarily impossible to extirpate the whole of the posterior horn of the cartilage, and I gathered that Mr. MacMurray believed that it did no harm to leave a small tab of cartilage. This has interested me particularly because in my last few operations I have used rather liberal incisions to permit removal of the entire cartilage. However, Mr. MacMurray's method is probably the better procedure.

At 4 o'clock, according to the time-honored and delightful English custom, all work was stopped and tea was served. We should adopt this custom in our country, as a means of increasing our

efficiency. The interruption of half an hour is just long enough to permit general relaxation and is very refreshing. During tea, Sir Robert was naturally the center of attraction and he radiated good cheer. He delighted particularly in relating how he overcame some of the obstacles he encountered when he was compelled to operate in the country with inexperienced assistants. One of these stories especially lingers in my memory. In travelling to perform an operation in the country he always took along a tight and rigid pair of operating gloves which were very difficult to put on. He and his nurse had an arrangement that when either observed the assisting physician to be careless or not conversant with proper surgical technique, he or she would suddenly announce the need of changing gloves. The nurse would give Sir Robert his gloves and the special pair to the assistant. While the assistant was laboriously pulling on his impossible gloves, Sir Robert, who is an unusually fast surgeon, completed the operation. All was well and the assistant none the wiser.

After tea there was a dry clinic in which Mr. MacMurray demonstrated a large number of cases of congenital dislocation of the hip treated by manipulation and by open operation. Their system of treatment of these cases is much like our own. They reduce the dislocation by manipulation whenever possible and reserve the open method for the resistant and more difficult cases. The results of the manipulation were unusually satisfactory as many of the patients had a practically normal range of mobility. Mr. MacMurray then showed a rather large series of cases of paralytic calcaneocavus in which Sir Robert Jones' operation of section of the os calcis and backward displacement of the posterior fragment was performed. These, from my point of view, did not have good results. There still remained a prominent heel, a heel gait, and an unstable ankle because the foot went into abnormal dorsal flexion during walking. There was a lack

of the firmness and stability of the ankle, and of the resistance of the foot against the leg that characterize the effectiveness of the Whitman astragalectomy with backward displacement of the foot. Mr. MacMurray then exhibited particularly favorable results from arthrodesis of the hip for osteoarthritis. At my request he described Sir Robert's method of mobilizing the hips in cases of very advanced osteoarthritis. This procedure is particularly valuable when both hips are involved. The steps of the operation are as follows: The great trochanter is cut off with the pelvitrochanteric muscles attached to it. The femur is cut across at the base of the neck and a liberal segment of bone is removed. The trochanter is then turned down and secured to the base of the neck. The shaft of the femur, now entirely detached from the neck, has free play. The result is a fair range of motion at the hip. I saw a very good result of this operation demonstrated in Dr. Allison's clinic, and was surprised that, although the femur is cut across, the limb is quite stable. Mr. MacFarland showed 2 cases of congenital dislocation of the knee reduced during infancy by manipulation. Both had excellent results. A vast number of cases was presented during this dry clinic. We all wished we had more time to study them and listen to the instructive remarks of Mr. MacMurray. The clinic was stopped at 6 o'clock, although there were many patients waiting to be exhibited, because we had to catch a train to go to London.

I learned a particularly interesting fact from Mr. MacMurray in regard to the economic value of the panel system in England. As you know in England the poor families are assigned to groups or panels, each of which is attended by a general practitioner at a stipulated amount per year. The assignment to a special panel is by mutual consent of the patient and the doctor. Each has the right of choice and refusal. The remuneration is small but fair and gives the panel physician

a satisfactory annuity. Mr. MacMurray assured me that the panel doctors had a good income and were pleased. This is entirely different from the state of affairs in Germany where the doctors receive such small remuneration that their work is virtually free, but with the disadvantage to the physician that he is compelled to treat a large number of patients both in their homes and in his office at all hours of the day and night. Then, too, in England, a patient belonging to a panel cannot, or rather through custom does not, visit a consultant without a letter of introduction from his attending physician. This materially diminishes the tendency to visit many clinics and many physicians in the same specialty.

The joint meeting of the British and American Orthopedic Associations was called to order at the Royal Society of Medicine at 9.30 A.M. on Thursday, July 4 by the celebrated Mr. Hey Groves, president of the British organization. There were present on the officers' platform in addition to Mr. Hey Groves, Sir Robert Jones, Dr. Fred Albee, Mr. A. S. Blundell Bankart, secretary of the British Orthopedic Association and Dr. De Forest P. Willard, secretary of the American Orthopedic Association. There was an audience of between 150 and 200 surgeons, among whom were the versatile Murk Jansen, the charming Jacques Calvé, and the handsome Vittorio Putti. Among the British surgeons present there were many who are well known to us through their work and writings, namely, Mr. Fairbank, Mr. Elmslie, Mr. Ollershaw, Mr. Platt, Mr. Bristow, Mr. Naughton Dunn and Mr. Laming Evans, all of whom have been identified with orthopedic surgery for many years. After a brief but very cordial welcome by Mr. Hey Groves on behalf of our British colleagues, the scientific session was begun.

The subject for discussion for the first day was fracture of the neck of the femur. Mr. Hey Groves read an interesting paper reviewing the different methods of treat-



ment and their results. His figures covered a rather small number of cases and showed what might be called only moderately satisfactory results. He used the abduction method and also the open operation with about equal frequency. He was, however, decidedly in favor of the conservative treatment. In the cases requiring an open operation he preferred a beef-bone graft to an autogenous peg. In general, he was not enthusiastic about the results in fractures of the hip, and emphasized the disadvantages that arise from the necessarily prolonged immobilization.

Mr. Groves was followed by Dr. Royal Whitman. Dr. Whitman received, as he mounted the platform, a very warm reception and loud and prolonged applause. Dr. Whitman briefly reviewed the mechanics involved in fracture of the neck of the femur, the purpose of treatment and the elements in the abduction treatment which aimed to meet the needs of the injury. In clear and convincing style, in few but beautifully chosen phrases he proved that the only logical treatment for a recent fracture of the neck of the femur was the abduction treatment. He expounded the theory and described the details of his reconstruction operation for old cases of fracture of the neck of the femur. He exhibited many lantern slides that proved beyond any doubt the truth and force of his statements. He presented such strong arguments in favor of the method he advocated, that the principles of his system of treatment were driven home to all of us permanently. When Dr. Whitman sat down there was, I am sure, no doubt in the mind of any surgeon present that the abduction treatment was the most effective procedure and the method of choice for the early cases of fracture of the hip, not only as a means of treating the injury, but as the best method of safeguarding the general health and the future welfare of the patient. This conviction was voiced by many in the discussion which followed.

Dr. Phil Wilson read a short paper on

the use of a special metal pin for fractured hips devised by Dr. Smith-Peterson. He exhibited the pin, with which we in New York are already acquainted, and related the results in the cases operated. Our British colleagues were impressed with its value and were much interested in the technic described by Dr. Wilson. Dr. Albee in his discussion was in favor of the use of an autogenous bone peg. He seemed surprised that it had not already been universally adopted. He exhibited Dr. Sterling Bunnell who had sustained a fracture of the neck of the femur and who obtained an excellent result from a bone peg operation done by Dr. Albee. Dr. Bunnell very kindly performed for us jumping upon a chair and going up and down the short flight of stairs leading to the platform, two steps at a time. Mr. Bristow showed 3 cases of fracture of the hip which had excellent functional results. He and Mr. Ollerenshaw definitely favored the use of the abduction method for all early cases. Dr. Whitman in closing the discussion presented Dr. Morrison of Brooklyn, who had accompanied us to Europe. Several years ago Dr. Morrison fractured his left hip but did not consult Dr. Whitman until one month after the injury. The abduction treatment gave him a firm union and a most satisfactory functional result. The doctor walked very well, without a cane or discomfort and without any concern about his hip. The morning's discussion of fractured hips left no doubt that, while bone pegging and the use of steel pins and other operative procedures may give good results in the hands of a few, the Whitman abduction treatment was the most direct and the most effective procedure for early cases at all ages. Its application was specially valuable for old people as it permitted the necessary hygienic care and change of posture imperative during a treatment which is inevitably long.

Dr. Putti read a paper on the diagnosis and treatment of congenital dislocation of the hip during early infancy. He aimed

to discover the dislocation before the child began to walk. With that in view, he has been training the public to bring their infants for routine examinations of the hip. His efforts are facilitated by the acquaintance of the people with this lesion on account of the vast number of cases of congenitally dislocated hips in Italy. He has found that the x-ray pictures of even very young infants who are going to have dislocated hips will show a diminution in the size of the centre of ossification of the femoral head, an upward displacement of the femur and a flattening of the acetabulum which are pathognomonic. Children whose hips show these defects are treated immediately by gradual abduction of the legs on a specially constructed triangular mattress or a double leg brace. The limbs are gradually abducted to the fullest and maintained in that attitude until the possibility or danger of a dislocation of either hip is passed. Dr. Putti feels that he has saved those children whom he has so treated from having dislocations. His series is still small. The paper was received with great enthusiasm as the new idea presented appealed to all of us as possessing considerable merit.

In the evening of July 4, the officers of the American Orthopedic Association were guests at a dinner given by Mr. and Mrs. Hey Groves. The cordial attitude of our British colleagues toward us was portrayed by Hey Groves on the cover of the menu. At the top were the British and American flags. Immediately below were two gloved hands representing the surgeons of both orthopedic associations in a firm and friendly clasp. Below the hands was the inscription July 4th, 1929, indicating that we were very welcome to the British on our Independence Day. In the middle of the page was a drawing of a fractured tibia and fibula. One tibial fragment represented Great Britain and the other the United States of America. The fragments were joined by an inlay graft of Friendship. Below this drawing was the

significant inscription "Natural Union without Artificial Ties or Foreign Bodies." The bottom of the page was decorated with drawings of an Albee electrically driven motor saw, a fracture of the neck of the femur cured by the abduction method and a Thomas brace.

After dinner we attended a reception at the Royal College of Surgeons of England. We were received by the President, Lord Moynihan, and Lady Moynihan and Mr. and Mrs. Hey Groves. Sir Arthur Keith delivered a lecture on the evidences of bone and joint disease in prehistoric times, showing specimens of bones with syphilitic lesions, myositis ossificans and skulls with numerous fractures and trephine holes. The Museum contained a vast collection of beautifully mounted pathological organs which stirred one to the desire to spend one's whole vacation studying them. In the Great Halls were portraits of some of the old masters in medicine by Sir Joshua Reynolds, Lawrence, Romney, Hogarth and others. The portraits are all interesting and in good state of preservation except that of John Hunter which is unfortunately blurred and rapidly fading. While we wandered through the building we listened to the strains of delightful music by the Marguerite Wortham Orchestra. The evening was terminated by the serving of delicious refreshments in the Library of the College.

The subject for Friday, July 5, was reconstruction surgery in paralytic deformities of the lower legs. In Dr. Henderson's absence Dr. Bruce Gill read his paper. Dr. Henderson reviewed the various procedures for stabilization of the knee and ankle joints with which we are all fairly familiar. He emphasized the advantage of combining tendon transplantations with bone operations. Mr. Laming Evans then read a paper in which he detailed the pathology of the various paralytic deformities and their treatment. He was very pessimistic about all tendon operations, stating that he had never seen a good result even from a

biceps transplantation for quadriceps palsy. The papers were followed by considerable discussion. Dr. Frank Ober confirmed Dr. Henderson's statement that the best results are obtained by a judicious combination of tendon transplantations with bone surgery. He exhibited lantern slides showing good results from the transplantation of the tibialis posticus for paralytic varus. Mr. Naughton Dunn emphasized the value of panarthrodesis. Dr. Leo Mayer described his method of physiological tendon transplantation, and demonstrated the technic in a series of very cleverly arranged muscle charts which he uses for his students. His method and exhibition were enthusiastically applauded. Dr. Whitman in his discussion pointed out very patiently the advantages of the astragelectomy with backward displacement of the foot in the stabilization of the ankle. At the end of the session I felt sure of three things: First, a strong biceps femoris muscle transplanted to the front of the knee for quadriceps palsy will give a good result. Secondly, an active tibialis anticus tendon transplanted to the outer side of the foot will maintain the correction of a varus and give a good functional result. Thirdly, an astragalectomy with backward displacement of the foot will stabilize the ankle in cases of paralytic calcaneus and dangle foot. Good results from these operations are practically assured if the surgeon uses proper technic. For all other conditions and in the use of any of the other methods, the results are uncertain and often only of short duration.

In the afternoon there were several operative clinics. About fifty of us went to Mr. Bristow's clinic in St. Thomas's Hospital. I saw Mr. Bristow remove an internal semilunar cartilage. He used a very short, almost transverse incision. He exposed the central part of the cartilage and lifted it up on a hook; he then rapidly freed and cut the extremities of the cartilage. The operation took only a few minutes and was performed with the skill of an artist. Mr. Perkins applied a Delbet

walking splint for fracture of the lower third of the leg and stated that he had had very good results with its use. Although the St. Thomas' Hospital is a very old one, having been opened by Lord Lister, the operating room equipment is modern and complete.

After the operations there was a demonstration of patients by Mr. Bristow, Mr. Perkins, Mr. Page and Mr. Brockman who won the Sir Robert Jones medal this year for research work in orthopedic surgery. There were exhibited a very large number of exceedingly interesting cases of osteochondritis dissecans, epiphyseal injuries, sunken acetabula, fixations of scapula for serratus magnus palsy, arthrodesis of the hip, coxa vara, arthrodesis of the ankle for malunited Pott's fracture, osteotomy for osteitis deformans, renal rickets and reconstruction of the hip. Mr. Page showed 2 cases of fixation of the scapula to a dorsal vertebral spinous process for paralytic wing scapula. The cosmetic and functional result was excellent. Several cases of Paget's disease were shown in which an osteotomy had been performed to correct lateral or anteroposterior deformity. The result was eminently satisfactory; the fracture united perfectly and the deformity remained corrected. The sectioned long bones of a case of advanced renal rickets in an infant were exhibited by Mr. Brockman. The bones showed marked changes at the epiphyses and explained the fuzzy appearance usually seen in the x-ray pictures of a rachitic lesion. The cases of malunited Pott's fracture for which an arthrodesis of the ankle was performed had particularly good results. The patients walked well and with a surprisingly elastic gait. The clinic terminated with a rather lengthy demonstration by Dr. Mennell of cork foot supports. He showed us how he prepares various cork splints for flat feet, anterior metatarsalgia and shortened limbs. His technic was clever, but the splints were rather bulky and clumsy, and not nearly so nice nor so effective as the simpler foot braces we make in our city.

The Dinner of the Associations was held on the evening of Friday, July 5, at the Cafe Royal. Sir Robert Jones was the chairman. Addresses were delivered by the chairman, Prof. Hey Groves, Dr. Albee, Dr. Joel Goldthwaite, Sir Squire Sprigg and by His Majesty the King of Portugal, who for many years has been interested in the rehabilitation of the disabled. The dinner was a huge success. The acquaintance of the American and British surgeons had already ripened into warm friendship, and both at the head table and throughout the room, there were frequent expressions of great satisfaction with the joint meeting.

On Saturday, July 6, six short papers were read by members of the American Orthopedic Association in the morning, and in the afternoon we visited the Lord Mayor Treloar Cripples' Hospital and College at Alton, of which Sir Henry Gouvain is the medical director. The Treloar Hospital and College is an institution for tuberculous children. It is located amidst beautiful country and occupies about 60 acres of ground. As the name implies it affords hospital care for the sick, and has a college for the training of these children who have recovered sufficient to be able to do some useful work. The hospital occupies many buildings and cares for a large number of children with tuberculosis of bones, joints, glands and the skin. The patients get excellent hygienic care and splendid orthopedic treatment. Heliotherapy is employed very extensively. There is one whole building filled with a large variety of electrical apparatus for the administration of heliotherapy. One is almost impressed that too much confidence is placed in this form of treatment. I never saw such extensive tuberculous skin lesions as we saw there. There were many cases with their ears and noses destroyed by the tuberculous disease, and no end of cases with severe facial disfigurement. All these lesions were healing, and the patients appeared in excellent general condition.

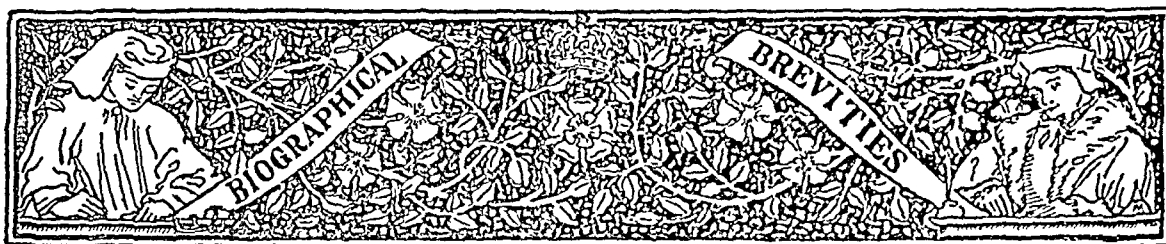
The institution is under the supervision of the Department of Education and hence there is ample provision for the instruction of all the children. The girls are taught weaving, basketry, knitting and sewing in all its branches. The College is located in a separate building at some distance from the hospital. In it boys between fourteen and eighteen years of age are taught the manufacture of shoes, clothes and leather goods. The atmosphere and the surroundings of the Treloar Cripples' Hospital and College are exceedingly cheerful and are not only conducive to an improvement in health, but also to the acquirement of a liberal education, a remunerative trade, and to the development of a sense of usefulness in the community.

We returned to London about 6 o'clock and bid our British colleagues farewell. They expressed the hope, and we the sincere wish, that they would meet with us in America in the very near future. The joint meeting of the British and Orthopedic surgeons established between us, living in widely separated countries, a feeling of nearness and intimacy, a sympathy and understanding that will inevitably lead to a more thorough appreciation of each other's work, and to the early adoption of the best methods of treatment for our patients. Thus ended a very delightful and instructive convention that I trust will be the forerunner of many more.

SAMUEL KLEINBERG.

## SOCIETY NOTICES

**B**EGINNING this year the American Association for the Study of Goiter will award a cash prize of \$300 annually for the best original thesis dealing with some phase of the goiter problem. Theses should be submitted by June 1, to Doctor Walter M. Simpson, Chairman of the Essay Committee, Miami Valley Hospital, Dayton, Ohio. The award will be given immediately following the coming meeting of the Association which is to be held in Seattle, Washington, July 10-12, 1930.



## "PURKINJE'S CELLS"

**J**OHANNES EVANGELISTA PURKINJE was born in 1787 in Bohemia. He was a scientist interested in many different fields of work but he is known to posterity as a pioneer in the employment of the microscope and also as a genius in the field of physiology.

Purkinje was the first to use the microtome, Canada balsam, glacial acetic acid, potassium bichromate, and the Drummond limelight in his microscopical labors.

In 1825 he described ("Symbolae ad ovi avium historiam ante incubationem") the germinal vesicle in the embryo. He was the first histologist to use the word or term "protoplasm." In 1833, in a student's dissertation, there was described his discovery of the sudoriferous glands of the skin with their excretory ducts. His other important discoveries include the pear-shaped ganglionic cells in the cerebellum (Purkinje cells), the lumen of the axis-cylinder of nerves and the ganglionic bodies of the brain. With Gabriel Valentin collaborating, he published his renowned article on ciliary epithelial motion. He described the fibers of the cardiac muscles (1839) and of the uterus (1840). He antedated Schwann by two years in his work on artificial digestion. It is interesting to read that he pointed out (1823) the value and importance of finger-prints, giving detailed and accurate descriptions of the figurations. This work was done long before that of Francis Dalton.

Purkinje noted that deaf-mutes can hear through their skull bones. He did solid work in his descriptions of most of the subjective visual figures.

In addition to his many-sided activities, he was a pharmacologist of renown. He used himself as a subject for experiments on the action of camphor, belladonna, stramonium and turpentine.

Clinically, Purkinje was the first to study the vertigo and rolling of the eyes produced by rotating the erect body in a vertical axis. He did not comprehend the scientific significance of much of this work, but it is considered to have been the starting-point of modern laws, principles and discoveries of vestibular and cerebellar nystagmus.

Purkinje early in life was a teacher. Before this he had taken orders. He was graduated in medicine at Prague in 1819. His inaugural dissertation was on subjective visual phenomena. It is related this earned him the friendship of Goethe. It has been said that this friendship got him the appointment of professor of physiology and pathology at the University of Breslau in 1823. He continued at this post until 1850 when he left to accept the chair of physiology at Prague. During his Breslau days he founded the method of laboratory training in connection with German University teaching. In 1824, he equipped a laboratory in his home. The work done by him and his pupils was of such worth that the Prussian government (1842) erected a Physiological Institute for him at Breslau.

Purkinje's brilliant work in so many fields brings him down the years and makes him loom large among the immortal figures of science of other centuries. He lived to a ripe old age and departed this life in his eighty-third year.

T. S. W.



JOHANNES EVAGELISTA PURKINJE

[1787-1869]

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BIOGRAPHICAL BREVITIES  
"Purkinje's Cells"

*The American Journal of Surgery*  
N. S. Vol. VIII, April, 1930





[From Fernelius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

## STUDIES IN PALEOPATHOLOGY, XXIII

### AN UNUSUAL SKULL FROM PRE-COLUMBIAN PERU

ROY L. MOODIE, PH.D.

SANTA MONICA, CALIF.

I HAVE considered in a previous paper<sup>1</sup> on "Surgery in pre-Columbian Peru," the association of skull injuries with trephined openings in an attempt to determine the exact relations of primitive surgery to depressed fractures. I have given there a number of illustrations showing an undoubted relationship; supporting the contention that prehistoric trephining was a deliberate attempt on the part of the primitive surgeon to relieve pain by elevating or removing the depressed cranial area, due to sling-shot wounds, club or mace injuries or by blows with other weapons.

After that paper had been sent to press I learned of a skull in the American Museum of Natural History, a pre-Columbian male skull in the Bandelier collections, which showed a most remarkable association of features which I consider sufficiently interesting to be separately described. I am under obligations to Dr. H. L. Shapiro, of the department of Anthropology, for a photograph of the right side of this Peruvian skull, given herewith.

There are three important features combined in this skull. First: the skull is

deformed artificially in the Aymara type, brought about by bandaging the plastic cranium of the young with a spirally wound cloth. Skulls of this type are seldom injured, and almost never trephined. The exceptions are given in my forthcoming paper. This skull (No.  $\frac{99}{3161}$  Amer. Mus.

Nat. His.), however, shows *both* trephining and injury, as may be seen in the photograph. I have never seen another example in which Aymara deformation, injury (depressed fracture) and trephining were so definitely associated, and I have examined several hundred ancient Peruvian skulls and have studied illustrations of many more.

The depressed fracture, itself, is interesting and unusual. A large, triangular area had been crushed in by a blow from a club. No radiating fracture-lines, nor comminuted fragments are evident. The lesion is partially healed. The edges are smoothly rounded and new bone in places has bridged the fracture line. No depressed fracture has been seen like this. It has no counterpart in the more than 160 crania in the San Diego Museum examined for skull lesions.

Near the middle line there is an oval trephined opening made by a cutting

<sup>1</sup>Moodie, R. L. Studies in paleopathology, xxiii. Surgery in pre-Columbian Peru. *Ann. Med. Hist.*, n. s. 1: 698, 1929.



instrument, possibly a copper knife or an obsidian flake. It appears to have healed somewhat, but we surmise that the tre-

phining was done *after* the injury, and probably to relieve pressure symptoms. The people who modified the skull into the Aymara deformation were for some reason, apparently, relieved of the occupation of fighting, since injured crania of this type are rare. They may have belonged to the priesthood who were devoted to the worship of the Sun. They may also have been members of the ruling

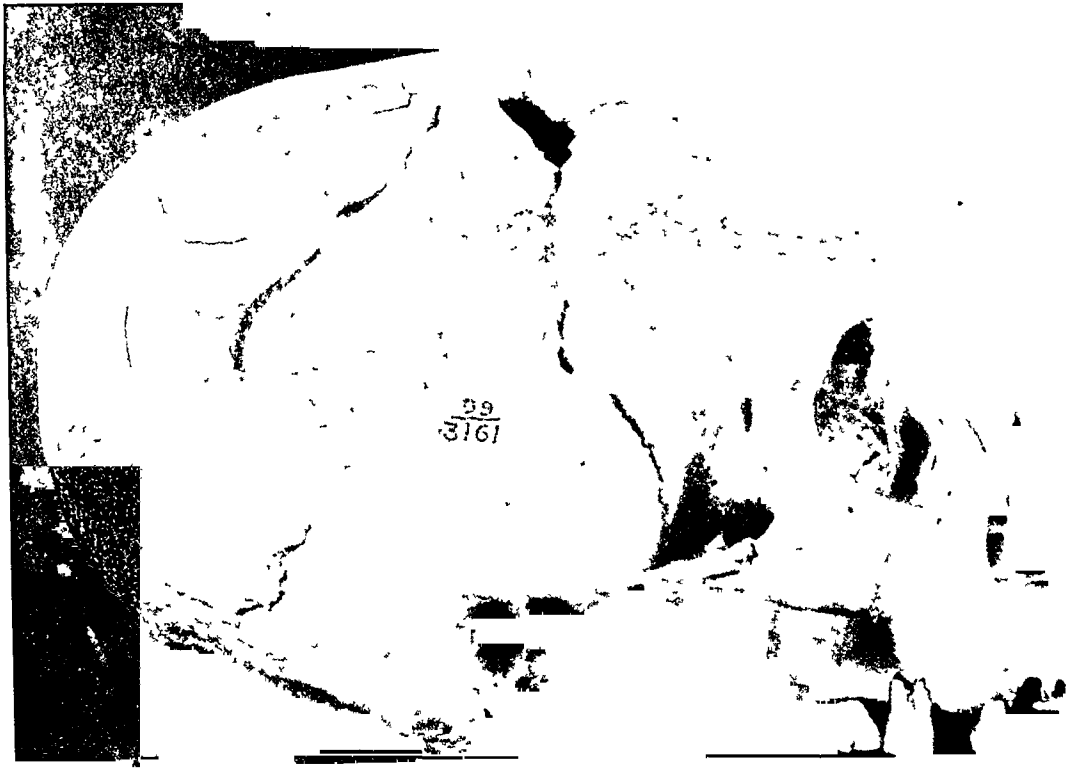


FIG. 1. Photograph of right side of ancient, male, pre-Columbian skull showing unusual association of (1) Aymara deformation, (2) depressed skull fracture and (3) trephining by the cutting method. (Courtesy Dr. H. L. Shapiro, Amer. Mus)

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is not an extreme instance of Aymara deformation, but is sufficiently well marked in the far-backwardly extending vault, to justify the classification.

Trephining was undoubtedly stimulated by war injuries, and since from the nature of the weapons most of the injuries were cranial, this phase of primitive surgery may have developed as a military measure.



# STUDIES IN PALEOPATHOLOGY, XXIV

## PREHISTORIC SURGERY IN NEW MEXICO

ROY L. MOODIE, PH.D.

SANTA MONICA, CALIF.

SOME time ago when Shapiro's paper<sup>1</sup> announcing the discovery of prehistoric trephined crania in the Southwest (New Mexico) appeared, I considered the incident as too important to medical history to let the matter rest. Accordingly I wrote Dr. Shapiro asking for enlarged photographs of the trephined areas. This was rendered the more important since the original illustrations were published on such a small scale as to render all details obscure, even under a magnifying glass. It was evident that the skulls had been trephined, and that was all. The accompanying illustrations are the results of that request.

My readers may recall that prehistoric trephining has never been known in America north of Mexico. It is true that cases suggesting trephining have been described, but doubt remained, until Shapiro announced the discoveries of the American Museum. Many years ago Hrdlička discovered trephined crania in northern Mexico. Nothing is known of this primitive surgical practice in the Maya area, nor do we know that it was practiced by the Aztecs. In pre-Columbian Peru the practice was highly developed and the details are given in a forthcoming paper. The practice was not known to the pre-Columbian peoples of Patagonia. It is extremely important to follow up this subject and all evidences should be carefully studied.

An examination of the illustrations will establish the authenticity of the two cases as of undoubted trephining. Tool marks around the edges of the openings, the nature of the apertures themselves substantiate the opinion of trephining. Recently I have seen an early Indian skull found at Beverly Hills, California, with two parietal openings simulating trephined openings, but the absence of tool marks and the possibility

of the openings being persistent parietal fontanelles render the evidence uncertain. The location of the two skulls in carefully-studied, stratified, refuse of a prehistoric pueblo in New Mexico, and the high reputation of the men making the discoveries has sufficed to establish the antiquity as prehistoric. Just how ancient these remains are cannot be told, but archeological evidences elsewhere in New Mexico reveals an antiquity of more than two thousand years for some of the inhabitants of the Southwest.

The cranium shown in Figure 1, discovered at Mitten Rock, New Mexico, in 1923, shows extensive pathological lesions of long standing. Nodules and depressions cover the entire vault. The trephined opening in the right frontal, immediately above the roof of the orbit, is roughly circular and includes the removal of most of the lower part of the bone. The lower left-hand border of the opening has invaded the right sinus frontalis. The opening is unusually large, measuring 40 x 50 mm. There are no evidences of healing. Considering the diseased nature of the skull it is probable that trephining was undertaken to relieve a long-established pathological condition. The right angular external process of the frontal shows evidences of a depression, indicating a depressed fractured area as the immediate cause of the operation. There are no marks of instruments beyond the sharply defined margins of the opening. Death doubtless ensued immediately after the operation. Shapiro thinks that the bone cut quite readily on account of its diseased condition. The skull is not artificially deformed, a rare condition in this archeological site where most skulls are deformed.<sup>2</sup> Shapiro regards the seat of operation as a dangerous one, but he does not say why. To my mind it is about as safe an area as any, but safety was not a

factor. The prehistoric surgeon was guided in his election by the depressed lesion, or by pain. It is interesting to note how

prevented artificial deformation. The individual seems to have reached the adult condition.



FIG. 1. Cranium found at Mitten Rock, New Mexico, by Earl H. Morris, during course of excavations in 1923, showing trephining by cutting method in right frontal. Opening measures about  $40 \times 50$  mm. Lesion shows no evidence of healing. Pathological lesions and depressions occur on vault. Skull is not deformed.

skillfully the surgeon avoided cutting into the orbital cavity. The skull bones are quite thin, possibly due in part to the long-standing disease. This diseased condition may have originated in early youth and

The other skull (Fig. 2), discovered by Dr. Louis R. Sullivan at Lamy, New Mexico, at the San Cristobal ruins, is interesting because of a number of factors. Its undeformed dolichocephaly is in sharp contrast

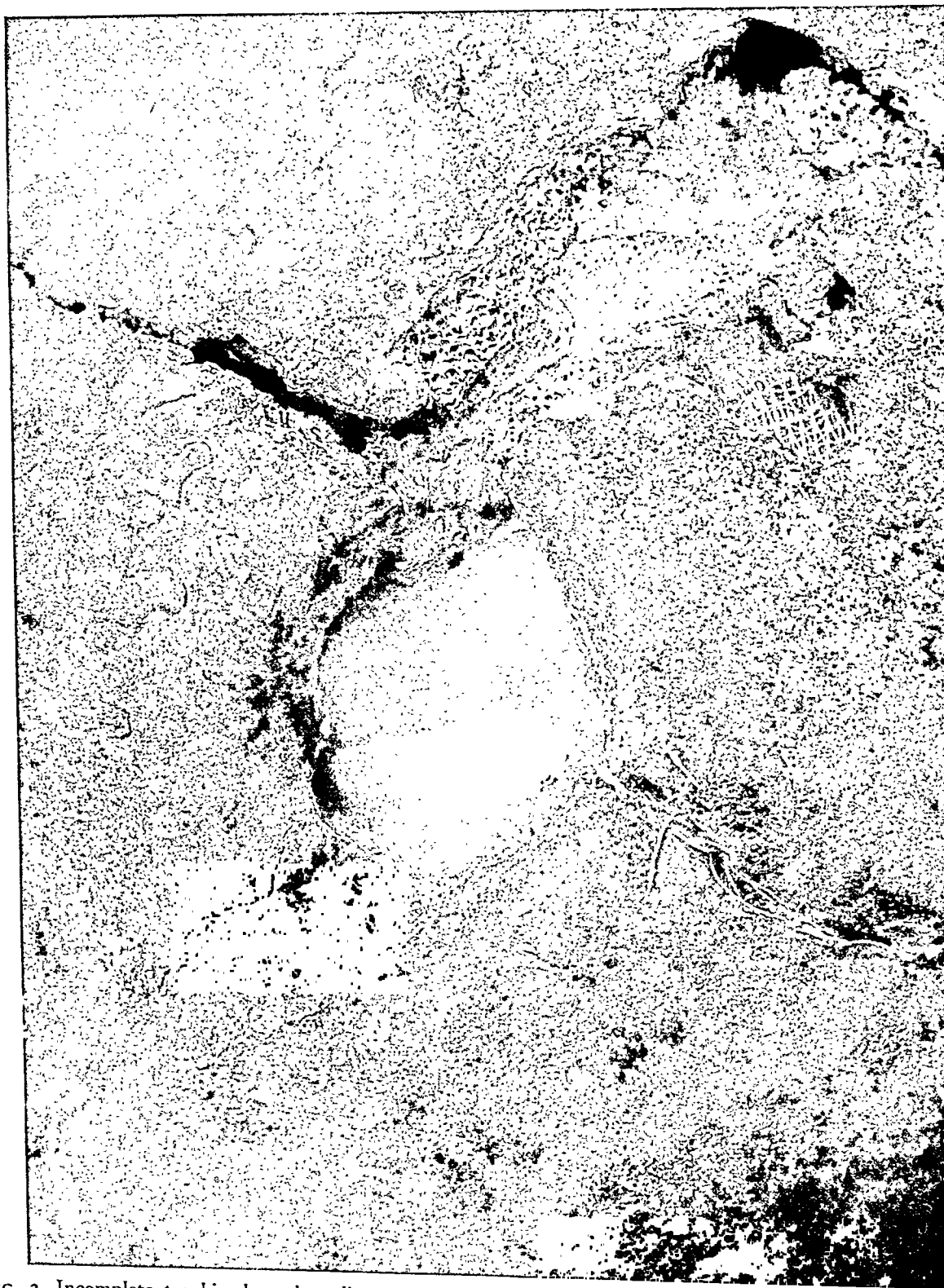


FIG. 2. Incomplete trephined cranium discovered by Louis R. Sullivan in 1923 at Lamy, New Mexico. Borders of trephined opening are bevelled and cicatrized, indicating that healing had set in. Operation seems to have combined scraping and cutting. There are no accompanying pathological evidences and the reason why trephining was performed is not known. Long diameter of trephined opening is about 20 mm. Wavy line on left is sagittal suture. Cotton and gauze are, of course, recent. (Courtesy Dr. H. L. Shapiro, American Museum.)

to the other skulls which are compressed fronto-occipitally. This skull may represent a visitor from a distance or a member of an earlier and unknown race.

In this case (Fig. 2), trephining was in the right parietal, about 1 cm. from the sagittal suture. The opening is roughly diamond-shaped, measuring 20 mm. in long diameter. The regularity of the opening and the beveled edges reveal clearly the nature of the trephining. It was by cutting and scraping. The borders of the opening show healing, new bone has covered the diploic spaces exposed by the operation, and on the endocranial surface new bony growth is evident. There are no evidences of disease or injury and we do not know why the operation was undertaken. The patient undoubtedly survived the experience and died months later from an undetermined cause.

A comparison of the two trephined openings just described with those known from Peru reveals some distinctive characters. No trephine opening in Peru has

the same location, shape or extent as that depicted from Mitten Rock, New Mexico, (Fig. 1). Only one other example shows invasion of the frontal sinus, and that was a deliberate attempt to relieve sinus headache. The shape of the opening is unusual. We do not know how important these factors are. The other skull, from Lamy (Fig. 2) shows an operated site which was commonly used in Peru for practice postmortem operations. While all phases of surgery were practiced in ancient Peru, cutting, drilling, scraping, sawing, etc., the two trephined openings from the Southwest are largely by cutting, with scraping a secondary and uncertain factor. These facts do not tend to show any close interrelation between prehistoric New Mexico and pre-Columbian Peru.

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1. SHAPIRO, H. L. Primitive surgery. First evidence of trephining in the Southwest (U. S.). *Nat. Hist.*, 27: 266-269, 1927, 2 figs.
2. SHAPIRO, H. L. A correction for artificial deformation of skulls. *Anthropol. Papers of Amer. Mus Nat. Hist.*, 30: pt. 1, pp. 5-38, 1928.



## BOOK REVIEWS

HUMAN BIOLOGY AND RACIAL WELFARE. Ed. by Edmund V. Cowdry, PH.D. 630 pp., illus. N. Y., Paul B. Hoeber, 1930.

One would have to be gifted in the art of using words and phrases and sentences to convey adequately to the reader the joy and solid pleasure in store for any person of education and understanding who begins reading this book. To me it read like a fast moving story written by a master. In fact, the book has been done by several master workmen.

Dr. Cowdry in his Preface, among other things, says: "The purpose of this book is to play a small part in breaking down these [extensive specialization] barriers in respect to the group of sciences which have a definite bearing on human welfare and are referred to collectively as "human biology."

The Introduction is by Edwin R. Embree. I read it twice. I would that I had space to quote from it at length. It would convince the

skeptic that here we have a book different yet more than worth while, a book not constructed for scientific men alone but for all who are commonly called educated. Embree begins his discourse and among other things says:

In an essay entitled "This Simian World" Clarence Day has considered what kind of planet this might be if some other species than the great apes had evolved into mastery. . . . We inherit some very great liabilities from these animal forebears. Our bodies are weak and puny as compared with the magnificence of elephants. . . . But we inherited in common with our monkey cousins, one great talent, namely curiosity. . . . Our chattering forebears have given us a love of talk. We are forever gabbling; we have invented great systems of languages; we even pay men to talk to us in groups. We store up words in scrolls and books, and build huge temples called libraries in which to hoard this preserved chatter. We compel children to devote years to the study of talk of previous generations. . . . We have also inherited a compulsion to action. We must always be busy . . . we rush about, we build and tear down and

build again. . . . Papers in the present volume discuss in fundamental terms various phases of the biology of man and his environment. Such presentation gives an approach to intelligent understanding of ourselves in our present state of development and in our present world.

The book is divided into five parts.

Part I is a chapter devoted to an essay on Life in Space and Time by Henry Norris Russell.

Part II has 6 chapters: Evolution Traced Biochemically, by A. B. Macallum; The Animal Ancestry of Man, by William K. Gregory; The Evolution of the Brain, by George H. Parker; Mental Evolution in the Primates, by Robert M. Yerkes; Societal Evolution, by W. M. Wheeler; Human Races, by Aleš Hrdlička.

Part III is composed of: The Vital Units Called Cells, by E. V. Cowdry; The Relation of Cells to One Another, by Alexis Carrel; The Integrative Action of the Vascular System, by W. B. Cannon; Nervous Integrations in Man, by J. F. Fulton and C. S. Sherrington; The Integration of the Sexes, by Clark Wissler.

Part IV covers: The Effects of Climate and Weather, by Ellsworth Huntington; The Reaction of Food, by Elmer V. McCollum; The Influence of Urban and Rural Environment, by Haven Emerson and Earle B. Phelps; Antisocial Behavior; Delinquency and Crime, by William Healy; Adjustment to Infectious Disease, by Hans Zinsser; What Medicine Has Done and Is Doing for the Race, by Sir Humphry Rolleston; The Relation of Science to Industry, by R. A. Millikan; The Influence of Education, by John Dewey.

Part V concludes the book with: The Inheritance of Disease, by Paul A. Lewis; Some Aspects of the Biology of Human Population, by Raymond Pearl; The Mingling of Races, by Charles B. Davenport; The Purposive Improvement of the Human Race, by Edwin Grant Conklin; The Intentional Shaping of Human Opinion, by H. A. Overstreet.

The Index is complete.

We list the subjects and authors feeling that this is the most impressive method of permitting the reader to reach his own conclusions; namely that this is a book more than worth while, a book human and absorbing and one of the truly important books of the year.

ELEMENTS D'INTERPRETATION RADIOSCOPIQUE ET RADIOGRAPHIQUE DES POUMONS. By Docteur, Loen Schekter, Boulogne-Sur-Mer, Paris, Doin, 1930.

In this little work the author claims that only the practicing physician can appreciate the full value of the radiological examination in the treatment of respiratory diseases. Without the x-ray examination, the clinical study is always incomplete and insufficient, but the radiographic study should not replace the clinical examination, or any of the other laboratory tests. A systematic screen examination should always be supplemented by films. An outline is given for the study of the diaphragm, the mediastinum, the esophagus and the parenchyma of the lungs and the points of differentiation between the various lesions.

While brief and sketchy, nevertheless the text serves to set forth the elements of interpretation, which is the author's object, as stated in the preface of the book.

A TEXTBOOK OF THE PRACTICE OF MEDICINE. Ed. by Frederick W. Price, M.D., F.R.S. (Edin.). Ed. 3. Oxford Univ. Press, 1929.

In almost 1900 pages of small type and thin paper there are the contents of a small "system of medicine." It is a pity that this work was not published in two volumes as the type and transparent paper make it very difficult reading (at least for the reviewer). Having stood the test, however, of three editions and six printings the book may be considered to have passed muster on its merits. There are twenty-six contributors who, to judge from the splendid literary quality of the work, have been chosen for their literary as well as their scientific abilities. As an up-to-date presentation of the practice of medicine, particularly from the British point of view, Price's textbook leaves little to be desired and the index of 110 pages is a model that other publications might well follow.

DIE CHIRURGIE DER BRUSTORGANE. Von Ferdinand Sauerbruch. Dritte Auflage, Erster Band, Die Erkrankungen der Lungen. Unter Mitarbeit von H. Alexander, H. Chaoul, W. Felix. Zweiter Teil. Chirurgische Behandlung der Lungentuberkulose Geschwülste der Lungen. Echinokokkus der Lungen Aktinomykose und Andere Pilzkrankungen der Lungen. Chirurgische Behandlung des Asthma Bronchiale. Syphilis der Lungen. Pp. 917-1373. Mit 189 zum Teil farbigen Abbildungen. Berlin, Julius Springer, 1930.

This part completes Volume I of Sauerbruch's classic, "Surgery of the Lungs." There are 189

illustrations, some of them colored, and all of them works of art. The detail in which the surgery of the lungs is taken up in this work is really a model for other publications. Though the book is not padded, a thorough test has found it answering every question that can be put to it. There is a bibliography of 146 pages and this is perhaps the best illustration that can be given of the interest in the subject. An expensive book, but one without which the armamentarium of anyone doing lung surgery is incomplete.

**GASTRIC AND DUODENAL ULCER.** By Arthur F. Hurst and Matthew J. Stewart, M.B. (Glas.), F.R.C.P. N. Y., Oxford Univ. Press, 1929.

Any book from the pen of Arthur F. Hurst is entitled to more than ordinary attention. A complete study of gastric and duodenal ulcer in which Dr. Hurst is assisted by Dr. Matthew J. Stewart, Professor of Pathology at the University of Leeds, is a publication of which every surgeon should take notice. This book of 544 pages with many illustrations and ten colored plates, unfortunately costs \$20.00, which makes the reviewer hesitate to make the recommendation he had in mind that "this book should be on the shelves of every practicing surgeon." It is, however, well worth the price for there is practically no question relating to gastric and duodenal ulcer that is not covered in this volume, beginning with an account of the earliest record of gastric ulcer reported in 1856 by Marcellus Donatus of Mantua and winding up with references to the latest cases reported. The authors and the

publishers have combined to produce, not only a valuable, but a beautiful book.

**SYMPTOMS OF VISCERAL DISEASE.** A Study of the Vegetative Nervous System in Its Relationship to Clinical Medicine. By Francis Marion Pottenger, M.D., LL.D., F.A.C.P. Ed. 4. 426 pp., 87 text illus. and 10 col. pl. St. Louis, C. V. Mosby, 1930.

A book that has gone through four editions may well be considered to have stood the test of time. Dr. Pottenger says in his Preface: "It has been my aim . . . not only to discuss the newer physiologic principles involved in the study of visceral neurology, but also to attempt to correlate them in such a manner as to make them readily applicable to clinical problems." This he has succeeded in doing. The book is well written, clear cut and authoritative. The illustrations are well selected and well executed. The bibliography makes no attempt at completeness, but covers all the essential references. It is a type of monograph of which there are all too few and every physician would be the better for a thorough study of this volume.

**ORTHOPÄDIE IM KINDESALTER.** Von Hofrat Prof. Dr. Hans Spitzzy, Wien, unter Mitwirkung von Geh. Hofrat Prof. Dr. Fritz Lange, München. 3. Vollig Umgearbeitete und Vermehrte Auflage. 510 pp., 253 illus. Leipzig, F. C. W. Vogel, 1930.

A well arranged monograph on surgical conditions met with in children, representing the best German teaching of the day. Profusely illustrated and well written, the book should be of interest to every orthopedist and pediatricist.



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SUPPLEMENT TO

# The American Journal of Surgery

A CLINICAL STUDY OF THE  
ABDOMINAL CAVITY AND PERITONEUM

EDWARD M. LIVINGSTON, M.D.

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# A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM

## SECTION I. THE CAVITY (*Continued*)\*

### E. INTRAPERITONEAL FLUIDS

Abdominal  
Distention

IT has been taught, using an alliteration, that abdominal distention may be due to (1) fat, (2) flatus, (3) feces, (4) fetuses, or (5) fluids. With the exception of the fluids, these substances which cause abdominal distention are lodged either within the viscera or within retroperitoneal spaces. Fluids, upon the other hand, often accumulate within the peritoneal cavity proper, where they gravitate freely about over the inner surface of the membrane. Thus while the peritoneal cavity, anatomically speaking, is normally empty except for that small amount of serous moisture which serves to lubricate its surfaces, it is subject to invasion by pus, blood, urine, bile, chyle, enteral contents, cyst contents, amniotic fluid, transudates, exudates; and the belly, which has been described as a muscular bag, may suddenly be turned into an elastic bottle, as is implied by the term ascites (Gr. *askos*, a leathern bag, bladder or bottle).

Diagnostic  
Problems

Free intraperitoneal fluids give rise to many diagnostic problems. Distention from fluids is not always easy to distinguish from that due to other causes. It is often difficult to differentiate free fluid from that which is encapsulated (tuberculous peritonitis), or from that which is present within some viscus (ovarian cyst, hydronephrosis); even an abnormal accumulation of some perfectly normal fluid presents diagnostic difficulties (distended bladder). After it has been definitely

\* The study, thus far, has consisted of a consideration of the abdomen as an empty space and each of the abdominal boundaries: roof, floor, and walls, has been systematically investigated. Before proceeding to a study of abdominal viscera, two additional subjects will be reviewed concerning the cavity itself: (a) that of free intraperitoneal fluids, and (b) that of intra-abdominal pressures. Preceding installments have appeared as follows: January issue, p. 193; February issue, p. 460; March issue, p. 693.

determined that free fluid actually exists within the peritoneal cavity, the clinician must still seek to settle other important problems. What organ or tissue gives rise to the fluid and what type of pathological process causes the accumulation? Is it of recent origin (hemorrhage) or has it existed in the cavity over a more extended period (malignant peritonitis)? Is the fluid likely to increase in amount (bile peritonitis; chylous peritonitis) or to diminish (receding pyogenic infection); is it septic (pus) or sterile (blood); does its presence call for immediate action (perforated ulcer) or is the situation less urgent (Pick's disease, cirrhosis): Should the treatment be surgical (acute peritonitis) or non-surgical (Bright's disease, cardiac disorders); if surgical intervention is demanded, is the indication for paracentesis, incision and drainage, or for a more extensive procedure?

Before dealing with the technical manoeuvres employed to detect intra-abdominal accumulations and to determine their exact nature, and before studying the clinical pictures produced by different substances which invade the peritoneal cavity, it will prove advantageous briefly to review some points of anatomy which serve to explain the distribution of fluids within the cavity (intraperitoneal drainage basins). The clinician, as the operating surgeon, should be familiar with the exact manner in which a given fluid arising from a given source tends to spread more widely over the peritoneal membrane. It is only through an accurate visualization of anatomical arrangements beneath the surface and beyond the scope of the eye that the examiner is in a position fully to appreciate the mechanism by which certain diagnostic evidence is produced (Clark's sign, Toma's sign, shifting dullness, engorgement of superficial veins).

I. WATERSHEDS AND DRAINAGE BASINS OF THE PERITONEAL CAVITY. The drainage of liquids within the peritoneal cavity is governed, in greater part, by the same physical laws which determine the flow or accumulation of water in geographic areas. A watershed is defined<sup>75</sup> as a "ridge separating

**Geological Basins**

the head-streams which are tributary to two different river systems;" it is "a parting, or a divide;" the term refers to any inclination, whether a mountain crest or a gentle slope, which determines the separation of fluids as they enter different catchment basins. The catchment basins themselves are referred to at times as watersheds.

#### Human Basins

The surgeon, in studying the great partitions (watersheds) of the abdomen and the pockets (drainage basins) within the peritoneal cavity, is confronted by problems which do not beset the engineer. A human "geological map" represents structures which are movable, not fixed. Human barriers are subject to variations and displacements. Pockets which exist in the dorsal decubitus are different from those of a sitting or semi-sitting position, and of ventral or lateral decubitus. The posture of the patient has much to do with the area in which free fluid accumulates; the clinician must know where fluid is reasonably to be expected and searched for. Likewise, a close correlation must be maintained between the site of an incision for drainage and the postoperative position which is to be employed. It is important constantly to visualize the changes which occur in intra-abdominal contours as the patient is moved from one position to another.

#### Intraperitoneal Catchment Basins

A simple conception of the drainage basins of the peritoneal cavity is that these are four in number<sup>76</sup> (Fig. 53):

- (1). A supracolic basin
- (2). A right infracolic basin
- (3). A left infracolic basin
- (4). A pelvic basin.

These four spaces are determined by three great barriers or watersheds:

(a) The transverse colon and mesocolon which jointly divide the cavity into the supracolic and infracolic spaces.

(b) The vertebral bodies, aorta, inferior vena cava and mesentery of the small intestine (mesentery proper) which together serve to create the right and left infracolic basins.

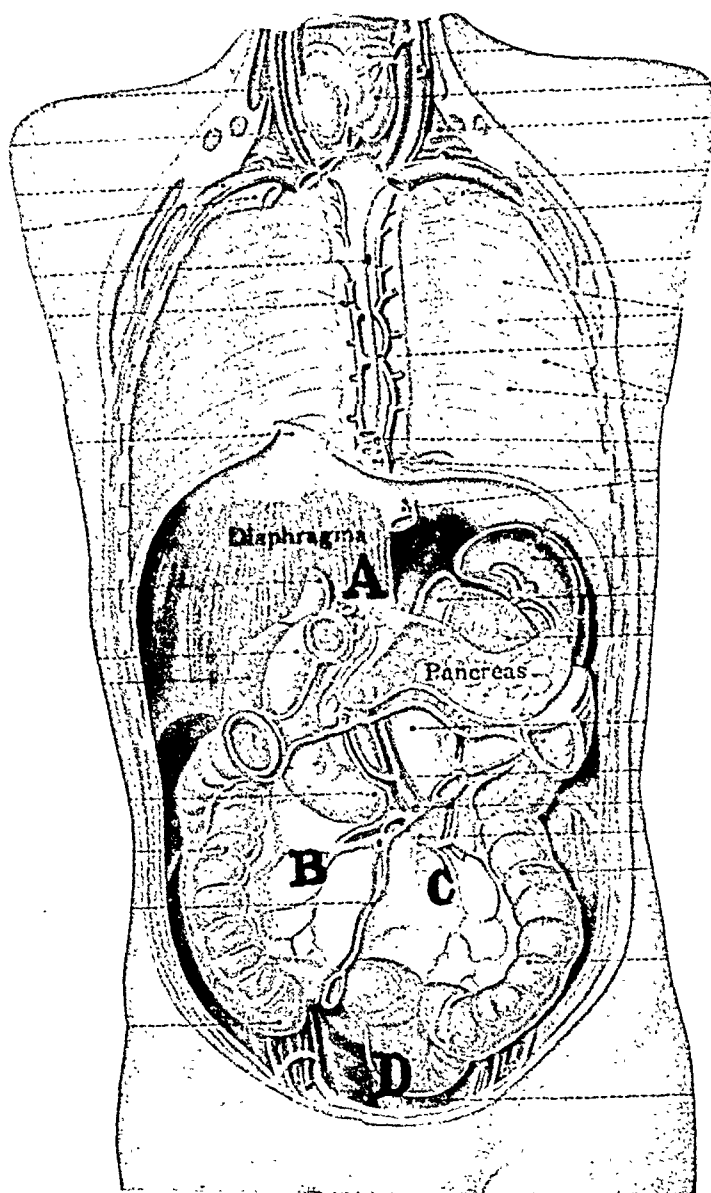


FIG. 53. The four chief intraperitoneal drainage basins. (His' model.)  
 A. Supracolic basin. B. Right infracolic basin. C. Left infracolic basin. D. Pelvis. (The stomach, liver, transverse colon, and small intestine have been removed.)

(c) The sacral promontory, acting with the psoas muscles and iliac vessels to separate the abdomen proper from the pelvis.

By another conception the cavity is considered to contain ten drainage basins, (A) five in the supracolic division, and (B) five below. These spaces are:<sup>77</sup>

(A) Those above the transverse mesocolon.

(1) The omental bursa

(2) A subhepatic space

(3) A perisplenic space

(4) A right subphrenic space, separated by the coronary and falciform ligaments from

(5) A left subphrenic space.

(B) Those below the transverse mesocolon.

(6) The right infracolic space

(7) The left infracolic space

(8) The pelvis

(9) The right paracolic gutter (running with the long axis of the abdomen between the ascending colon and right parietal wall)

(10) The left paracolic gutter (running in the interval between the descending colon and the left parietal wall).

Further subdivision of the peritoneal cavity serves to introduce a confusing terminology and to pass beyond practical surgical fields into those which are more strictly anatomical.

Spreading  
Peritonitis

The several abdominal drainage basins communicate more or less freely with one another (Fig. 54). For example, free fluid from a perforated gastric ulcer may first invade the subhepatic space or the omental bursa, then spread upward to the right subphrenic area, or again extend downward along the right paracolic gutter (there to simulate the peritonitis associated with a perforation of the appendix); it may even pass onward into the pelvis, and when sufficient accumulation has occurred, the fluid may well upward out of the pelvis to involve either subcolic fossa or to pass into the left paracolic

groove, to extend farther upward into the perisplenic space. A spreading peritonitis, as a spreading infection of the hand, travels onward by way of fairly fixed channels. But often this

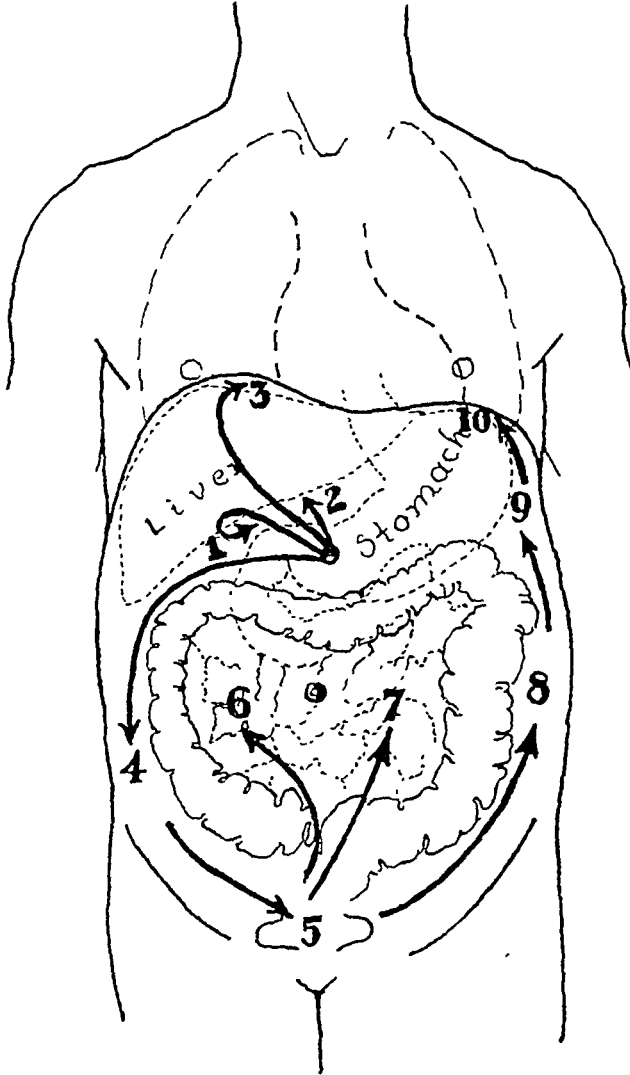


FIG. 54. Spreading peritonitis. Communication of the "drainage basins" of the peritoneal cavity.

1. Subhepatic space. 2. Omental bursa. 3. Right subphrenic space. 4. Right paracolic gutter. 5. Pelvis. 6. Right infracolic space. 7. Left infracolic space. 8. Left paracolic space. 9. Perisplenic space. 10. Left subphrenic space.

spread may be checked in the space originally invaded, as further extension is anticipated through a proper placement

of drains. In speaking of abdominal infections as passing "upward" or "downward," authors refer to the anatomical or erect posture; but when patients assume some other position, these pockets or basins may no longer lie one above the other, but be on practically the same level, forming a single pool. (See Morison's space, p. 171.)

Anatomy of the  
Perpendicular  
Barrier

The Root of the  
Mesentery

The position of the so-called "perpendicular barrier" is slightly oblique to the long axis of the body. The vertebral column and the large abdominal vessels follow the midline, but the mesentery of the small intestine (the mesentery proper) is attached in a line which runs from above downward in a direction which is slightly oblique and to the right. The root of the mesentery is approximately 6 inches long. While subject to some variation as to its obliquity and exact course, the point of origin is constant, being located at the duodeno-jejunal juncture at the lower border of the pancreas to the left of the second lumbar vertebra. Passing diagonally over the aorta, inferior vena cava, right ureter, and psoas major muscle, it reaches a variable point in the right lower quadrant. Free fluid to the right of the mesentery, therefore, is carried to the right lower quadrant of the abdomen, while that on the left passes into the pelvis. Hence, collections of blood and pus are much more frequently encountered in the right lower quadrant than in the left.

Anatomy of the  
Transverse Barrier

The second great abdominal watershed or barrier is the transverse colon and its mesocolon. Above this partition, generally speaking, lie all of the solid organs: liver, pancreas, spleen, adrenals, kidneys, also the gall bladder and the gastric portion of the gastrointestinal tract; while below are found intestines only. In studying this barrier as a watershed, several points warrant special observation: (1) The root of the mesocolon is attached at the level of the first lumbar vertebra. It does not extend backward to the prevertebral fascia but overlies all of the other prevertebral structures (duodenum, pancreas, great vessels). (See section dealing with the rotation of the intestines for explanation of this arrangement.)

(2) It does not lie, as the name might imply, on a plane which is strictly transverse to the long axis with the cavity, but has a definite obliquity, due to the higher attachment of the left than of the right flexure of the colon. (3) The length of the transverse colon itself (19 to 20 in.) is nearly twice as great as the length of its mesentery. This barrier is, therefore, smooth only at its base and has deep waves and irregularities near its anterior margin. (4) The colon lies at a variable distance below the root of its mesentery, hanging at times in a v-shaped or u-shaped formation as low as the pelvis. Being attached to the stomach by the gastrocolic ligament, movements of the stomach and of the colon are necessarily somewhat similar and synchronous. (5) Due to the down hanging of the transverse colon on its mesentery, the barrier when viewed from the side has a sharp, though varying, obliquity which makes the highest part of the infracolic division of the peritoneal cavity actually higher than the lowest part of the supracolic division, i.e. the supracolic overhangs the infracolic compartment. (6) Anteriorly the barrier (transverse mesocolon) is sealed through a large part of its course by the gastrocolic ligament. Behind this ligament the barrier forms a part of the floor of the omental bursa (described with the gastrointestinal tract). Since the omental bursa is closed above, below, in back, in front and to the left, fluids can drain only to the right, or through the foramen of Winslow, passing into Morison's space (see p. 171). The portion of the transverse mesocolon to the right of the gastrocolic ligament is not anatomically sealed anteriorly, but the location of the transverse colon and the great omentum, directly in contact with the anterior abdominal wall, effectively prevents leakage to the general peritoneal cavity through this route. As previously noted, drainage is almost invariably to the right, extending downward to the paracolic groove. (7) The transverse mesocolon is wide only toward its center and to the left of the midline, while both extremities (near the right and left colic flexures) have either very short mesenteries or none at all,



being attached to the parietes only by areolar tissue. This is particularly true of the right side where the mesentery has appreciable width only after the left border of the head of the pancreas has been reached, i.e., almost at the midline of the body. (See transperitoneal removal of the kidney.) The practical application of these considerations will be referred to at many subsequent points in the text.

#### Morison's Space

2. SURGICAL DRAINAGE. With these intraperitoneal spaces freshly in mind it seems advantageous briefly to review the methods best adapted for securing adequate drainage of the cavity. A drainage basin of great importance is that known as Morison's space.<sup>78</sup> This consists of the subhepatic space, combined with the upper part of the right paracolic gutter. The space receives leakage from the gall bladder, the biliary ducts, the duodenum, and from a greater part of the stomach; in addition, it may form a basin for the extension of infections from pelvic organs or from the appendix, especially when the latter is retrocecal. The space, previously potential, is exposed by lifting the free border of the right lobe of the liver upward, away from the colon, after the abdomen has been entered through a right rectus incision. The upper wall of the space is composed largely of liver and gall bladder and it extends as far to the left as the opening into the omental bursa (foramen of Winslow), located at the right margin of the gastrohepatic omentum; it extends downward and backward reaching to the posterior abdominal wall, where the peritoneum stretches over the right kidney and duodenum; the lowest part of the space is bounded by the upper margin of the transverse mesocolon and the right flexure of the colon, but externally (to the right) it extends downward between the ascending colon and right parietal wall as far as the iliac crest; internally the space is bounded by the peritoneal reflexion covering the spinal column. A more detailed description of the space is given in the exact words of Morison in the section on Eponyms (p. 171).

The route for draining this space, as advocated by Morison, reaches the most dependent part of the area, both for the sitting

posture and the dorsal decubitus. The drain is introduced through the posterior parietes immediately below the lower end of the right kidney, i.e., just above the right iliac crest and below the extremity of the twelfth rib. The drain may be inserted through Petit's triangle, the base of which occupies from 1 to 2 inches of the iliac crest just posterior to its mid-point; or it may be passed through the muscles immediately posterior to this triangle. Internally the drain passes in front of the kidney and behind the liver, traversing the hepatorenal pouch, and extending upward to the region of the biliary ducts. This route for lateral and dependent drainage through the hepatorenal pouch may be visualized by *imagining* a 4 to 6 inch opening in the side of the body extending upward in the posterior axillary line from the iliac crest; the hand, slipped into this opening, would lie within the hepatorenal pouch as within a glove, the kidney behind, the right lobe of the liver in front (Fig. 55). Morison states that approximately a pint of fluid may be placed into this pouch before any spills into the general peritoneal cavity and that with lateral drainage through the route described it is even possible to drop the open gall bladder into the peritoneal cavity or to leave unsutured a large hole in the common or cystic ducts without causing generalized peritoneal contamination. Drains may be inserted into the hepatorenal pouch either from within outward or from without inward. During an abdominal operation the drain may be inserted under direct vision, or through palpating the depths of Morison's space as a small stab wound, thus controlled, is made in the parietes.

Drainage through  
the Hepato-renal  
Pouch

The biliary drain so often employed (a prophylactic wick in the subhepatic space) does not reach the lowest point of the hepatorenal pouch into which all leakage actually occurs. Such a drain may frequently, or even usually, prove adequate but it must be recalled that the drainage desired is not that of the ducts themselves, but of a basin into which the ducts leak. Thus there are times when simple subhepatic drainage may prove inadequate. This is evidenced in cases

where the discharge through the wound is profuse and seems adequate when judged by the degree of saturation of the outer dressings, but where a moderate upward pressure over

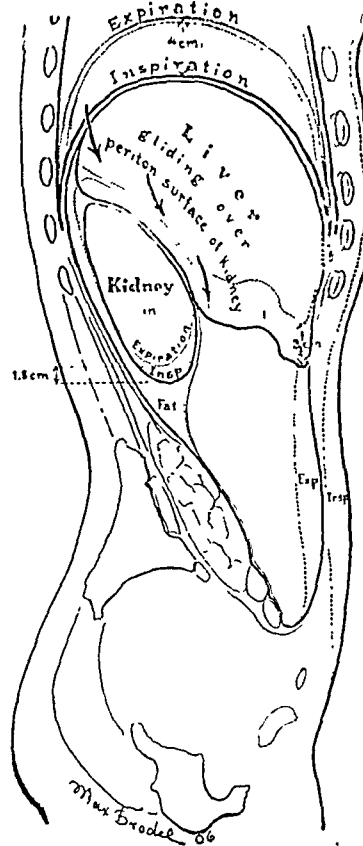


FIG. 55. Diagram showing relation of liver and right kidney; the hepatorenal pouch. The influence of respiration on the right kidney is also shown. A movement downwards of 1.5 cm. of the kidney may be regarded as the average amount in quiet respiration. (From Kelly and Burnam's "Diseases of the Kidney, Ureters and Bladder," D. Appleton.)

the outer side of the ascending colon will cause a large quantity of residual fluid to well forth from the incision. With such definite evidence of inadequate drainage a secondary drain may be inserted through the lowermost part of Morison's space.

The right infracolic space, when viewed from the front, presents a triangular appearance, due to the obliquity of the

mesentery of the small intestine. The base of the triangle consists of the inferior leaf of the transverse mesocolon; the right limb is formed by the ascending colon and cecum; the left limb of the triangle consists of the right side of the mesenteric root. The upper, outer angle is formed by the right colic flexure; the upper inner angle is the spinal column at the level of the second lumbar vertebra, and the inferior part of the duodenum crossed by the superior mesenteric vessels; the lower angle, or apex of the triangle, approaches the cecum and vermiform appendix, but remains partly open, providing a narrow communication into the pelvis. The inferior third of the right kidney may be palpated and examined below the right colic flexure in the upper, outer angle of the triangle. To inspect the right infracolic space thoroughly the coils of small bowel lying within the area should be moved en masse downward and to the left,<sup>79</sup> i.e., displaced upon their mesenteric hinge. The right infracolic space is drained either through the anterior abdominal wall, or through the lateral wall, the drain in either case being carried to the center and depths of this basin. (See Fig. 53.)

Drainage of the  
Right Infra-Colic  
Spaces

The left infracolic basin is bounded superiorly by the left third of the transverse mesocolon, medially by the vertebral column and left leaf of the mesentery, laterally by the descending and sigmoid colon. The shape is not so definitely triangular, since inferiorly there remains a wide and direct communication with the pelvis. The left kidney is palpable within this basin, lying beneath the left colic flexure. The duodenojejunal juncture is located at the upper, inner angle of the space. The left infracolic space reaches a higher level than the right infracolic space, due to the high fixation of the right flexure of the colon (the obliquity of the transverse mesocolon). (See Fig. 53.) To examine this drainage basin the coils of small intestines may be displaced upon their mesentery upward and to the right. The left infracolic space is drained either directly or through the pelvis, the pouch of Douglas in the female and the rectovesical pouch in the male, as discussed later.

Drainage of the  
Left Infracolic  
Space

## Pelvic Drainage

Pelvic drainage may be secured through a suprapubic incision, an incision in either lower abdominal quadrant, through the vagina, the perineum, or through the rectum.

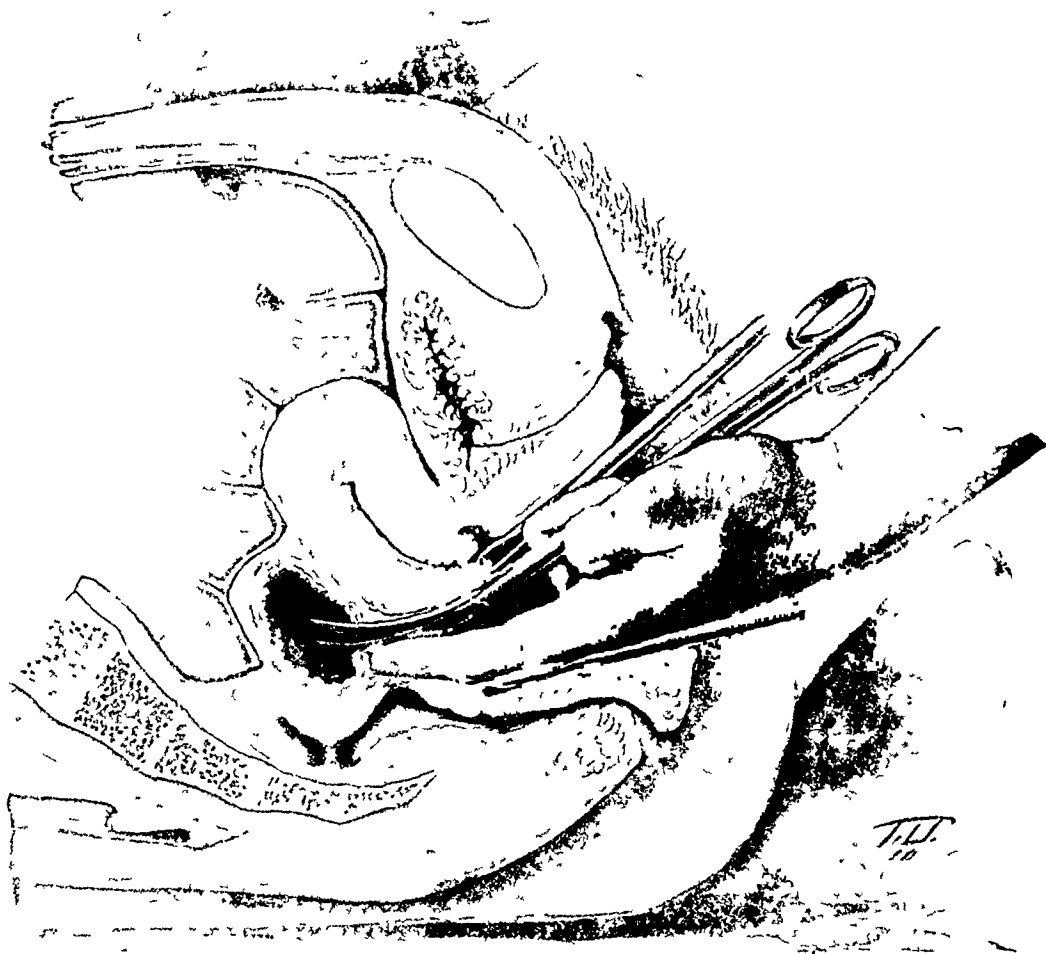


FIG. 56. Posterior colpotomy for drainage of pus which has gravitated to lowest portion of peritoneal cavity. Penetrating abscess wall. The sharp-pointed scissors, under the guidance of the finger, have been introduced into the mass and then opened widely. (From Crossen's Operative Gynecology, C. V. Mosby Co.)

In instances of diffuse or spreading peritonitis and when an abdominal incision is already present, drainage is usually accomplished from above. But a favorite method for the drain-

age of a chronic pelvic abscess in a female is to enter the pouch of Douglas by way of the posterior vaginal wall (posterior colpotomy) (Fig. 56).

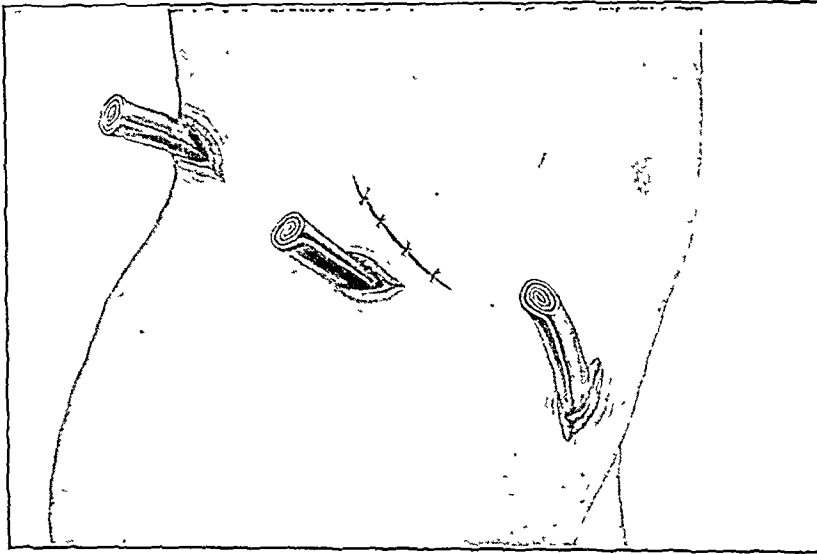


FIG. 57. Stab wound drains: (a) to the pelvis; (b) to the right infracolic space; (c) to the right paracolic gutter. These three drains might all have been brought to the surface through the operative wound. (From Royster's "Appendicitis," D. Appleton.)

A consideration of methods for practical drainage of infectious material from individual abdominal organs may serve as a review of the drainage basins and their communications:

*Appendix.* Operations of the "interval" type and for a subacute or non-perforative variety of appendicitis may be concluded without drainage. In the presence of a moderate leucocytosis or slight localized peritoneal exudate it may prove wise to carry a "prophylactic" wick to the site of the appendicular stump in the right subcolic fossa. A retrocecal abscess may be drained through the loin or by passing a drain from the anterior wound to the right paracolic gutter. In the presence of a spreading or diffuse peritonitis three drains may be utilized: one to the right paracolic groove, one to the right infracolic fossa, and one into the depths of the pelvis (Fig. 57).

Drainage of Individual Organs

*Gall Bladder.* Drainage of this organ both through the abdominal (ventral) wound and through the hepatorenal pouch, has already been discussed.

*Duodenum.* Leakage from most duodenal perforations occurs into the subhepatic portion of the supracolic division of the abdomen and there may be drained through the ventral wound, but preferably through the route of Morison (hepatorenal). The peritoneum takes care of duodenal leakage in a remarkable fashion providing the perforation is promptly and adequately closed. Leakage into the omental bursa may be drained as later described.

*Stomach.* Perforations of this organ may involve the subhepatic space (usual), the omental bursa, the perisplenic area (rare) or the general peritoneal cavity. The omental bursa empties into the subhepatic space through the foramen of Winslow and may be drained as described in the discussion of Morison's space. It may also be drained through an opening in the gastrocolic ligament, through the great omentum, or from below through the transverse mesocolon. The perisplenic space may be drained by means of a wick carried directly to the depths of this basin, either through a high left paramedian incision or a stab wound in the left parietes; such drainage may or may not be associated with drainage of the left paracolic gutter.

*Spleen.* (See perisplenic space).

*Pancreas.* Drainage may be established through the omental bursa (by any of the several routes described), through the left posterior parietal wall (retroperitoneal extravasations), or through the cystic duct (cholecystostomy for pancreatic congestion).

*Pelvic Organs.* (Previously described.)

*Kidney.* Perirenal infections may be drained retroperitoneally by means of an incision in the posterior or lateral parietes.

*Bladder.* The space of Retzius may be drained (retroperitoneal drainage) suprapubically through the midline alone or through multiple incision.

*Subphrenic Abscesses.* (See chapter dealing with the diaphragm.)

Just as gravity plays a great part in determining the site at which pus and other fluids will accumulate, so it also plays an important (though by no means the only) rôle in securing effective drainage. The pelvis is fittingly termed "a basin," not only on account of its shape but also because when patients are placed in the upright or the semisitting posture (Fowler position) fluids gravitate to this cavity; the most dependent point at which to drain the pelvis is through the pelvis floor. The space of Morison is reached at its lowest point by way of the hepatorenal pouch (route of Morison). The perisplenic space is given dependent drainage through inserting the wick into the lowest part of the left paracolic gutter to which perisplenic abscesses tend to gravitate. The left subcolic space is often adequately drained only when the drainage material has also been carried into the pelvis. The value of the Fowler position in diminishing the spread of septic material throughout the peritoneal cavity and in minimizing absorption will be more fully discussed in the section dealing with the peritoneal membrane. Placing a pillow beneath the left hip and shoulder may aid in securing drainage when there is an incision in the right loin, and a similar support or elevation of the right side of the body aids in securing drainage to the left.

**Influence of Post-operative Posture on Drainage**

When the original incision is made at a site other than that which gives dependent drainage it is often advantageous to place a secondary drain through a stab wound at the desired site. Small stab wound incisions may be easily, safely and bluntly made under the guidance of the hand within the abdomen. In addition to yielding the maximum advantage from position such secondary wounds prevent the pus from soaking the main operative wound and thus reduce the likelihood of wound infection and subsequent hernia formation.

3. METHODS FOR THE CLINICAL DETECTION OF FLUIDS. The clinician uses special technical terms in referring to

**A Special Terminology**



abnormal fluid collections throughout the body. *Dropsy* signifies either an extensive and marked "water-logging" of the entire system such as is observed with certain cardiac and renal disorders, or a more localized morbid accumulation of watery liquid within some cavity or within the tissues themselves. The term *hydrops* (an abbreviation for Gr. water + dropsy) literally means the same, but in ordinary clinical usage indicates a watery collection within some special organ or space, as *hydrops vesicae felleae* (an accumulation of clear, or non-bile-stained fluid within the gall bladder) or thoracic *hydrops* (a pleural effusion).

*Anasarca* (Gr. *ana*, through + *sarx*, flesh), like the word dropsy, means a generalized infiltration (a seepage throughout the flesh) of thin, clear, or watery fluid. Any cystic swelling containing serous fluid is termed a *hygroma* (Gr. water + tumor, for example a housemaid's knee or a compound ganglion the wrist). The term *edema* (Gr. swelling) implies a puffiness at due to the choking of the areolar tissues and interstices of the involved part by abnormal amounts of liquids. The word *fluid* itself (L. *fluidus*, flowing) signifies the presence of a substance which is non-resistant, non-solid, or mobile, hence the term *effusion* (L. *e*, out + *fudare*, to flow) suggests quite a different pathological process from that of *exudation* (L. *e*, out + *udare*, to sweat, or produce in beads). An effusion is a rapid outpouring of thin liquid while an exudation is a more laborious liberation of a thick, viscid, or more organized substance. The derivation of the term *ascites* has previously been referred to (Gr. *askos*, a water bag).

Laws Regarding  
Fluids

Fluids within the body, as fluids elsewhere, possess typical characteristics and are governed by laws which are peculiar to themselves.

a. Fluids are particularly weighty (1 cu. ft. of water weighs about 1000 oz., 28.5 kg., or roughly 63 lb.), and the total weight of the body is largely due to the fluid which it contains. This fact readily explains why a patient with cancer who has undergone, or reasonably should have undergone, a considerable

loss of weight may suddenly acquire new weight with the onset of ascites or dropsy; and since water is over 700 times heavier than air, a hydrocele may often be differentiated from an enterocele by simply picking up the mass within the palm, in order to estimate its specific gravity.

b. Water is a poor conductor of heat and when the fluids of edema block the tissue spaces, obliterating superficial blood vessels, the involved part may seem abnormally cold. The temperature of a boggy extremity gives no fair index as to the condition of its deep arterial supply and the vascular efficiency is better estimated through palpating the peripheral pulse or through taking the temperature of a non-edematous portion such as the toes or fingers; again, in the early stages of an acute inflammatory process the local temperature appears elevated but after a large collection of pus has formed the temperature may actually seem lowered, while an incision carried through edematous tissues overlying an abscess may show the boggy area itself, even though cold, to contain pus.

c. Fluids are substances incapable of resisting forces; they follow pathways of least resistance; while a solid possesses both size and shape, a liquid has size but not shape. As already discussed free fluids within the peritoneal cavity move about, flowing along the watersheds and into the catchment basins under the influence of gravity. Free fluids seem to "swish" or yield in a perfectly characteristic fashion beneath the examining hands.

d. Fluids are almost totally incompressible (under a complete additional atmosphere of pressure water is condensed by only 1/20,000 of its bulk). Intestines filled with fluid, then, are far more likely to be ruptured by a sudden force such as a kick than are those filled with gas; similarly, the empty or semi-empty bladder is ruptured with difficulty, while the distended bladder may burst from comparatively slight trauma.

e. Bodies immersed in fluid must displace their own bulk (Archimedes' principle). Hence the patient with respiratory

and cardiac embarrassment due to a marked ascites will suffer from additional discomfort after eating, especially when the food is poorly selected as to bulk; conversely, the removal of a copious liquid or formed stool will reduce the pressure within the abdomen and within the ascitic fluid itself.

f. Any additional pressure exerted upon an enclosed fluid mass is transmitted equally in all directions (Pascal's law). A venous varix in the femoral region may be differentiated from a femoral hernia by simply tapping upon the associated varicose veins of the leg while testing with the opposite hand over the mass for a transmitted fluid wave. Again, when a marked ascites is associated with an umbilical bulge, tapping at almost any point on the belly wall will be followed by a perceptible movement or expansion within the umbilical nodule. It follows from Pascal's law that no sustained tangential pressure can be exerted through a fluid mass. Lateral pressure over an abdomen distended with fluid will transmit to the opposite side a momentary impulse or "a fluid wave" but lateral pressure along this tangent is never sustained since the force is immediately distributed equally in every direction. This dissipation of pressure often serves to differentiate a fluid mass from a solid mass, for a tumor frequently may be pushed about or rocked from side to side.

The clinical picture caused by free intraperitoneal fluid will depend to a considerable extent upon the amount of fluid present, i.e. whether the quantity be marked, moderate or slight.

(1) *When the accumulation is marked* the findings are as follows (Fig. 58):

**The Physical  
Examination**

*Inspection* reveals a typical picture.

The abdomen is symmetrically distended.

The belly appears globular or barrel-shaped.

The skin is tense and glistening; striae may be present.

The umbilicus is prominent or protruding.

The intercostal angle is widened; the lower ribs bulge; the abdomen is out of all proportion to the thorax as a whole.

The abdominal respiratory movements are diminished or absent.

The legs, thighs and scrotum may be edematous.

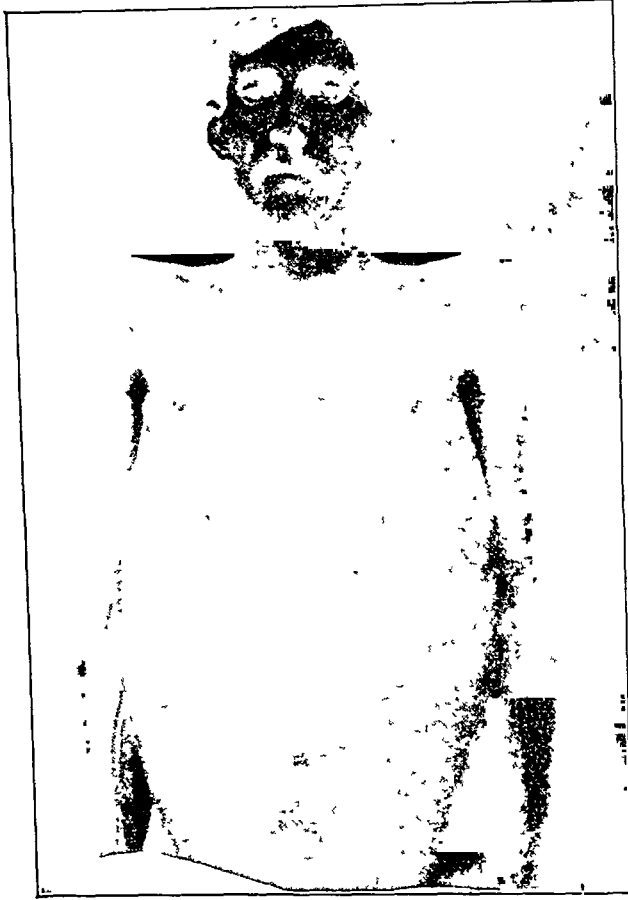


FIG. 58. General enlargement of the abdomen from abdominal dropsy (ascites). (From Anders' "Physical Diagnosis." D. Appleton and Co.)

Hernial weaknesses in the walls bulge and are filled with fluid.

The superficial veins may be engorged; congestion of the hemorrhoidal and pampiniform plexuses and a complete or partial caput Medusae are sometimes present.

*Palpation.* A fluid wave or thrill is present; this does not disappear as pressure is made upon the anterior abdominal wall.

Percussion at any point yields a visible enlargement of palpable thrill within the protuberant umbilicus.

Dipping or ballottement may be detected where a solid tumor or enlarged liver underlies fluid.

The cardiac impulse may be displaced upward, or upward and slightly to the left.

The abdomen feels tense and characteristically weighty; this tension and peculiar resistance are most marked in the bulging flanks.

*Percussion.* The flanks and suprapubic regions are flat or dull or the dullness may be generalized.

Tympany, if present, tends to be central in location.

*Mensuration.* When the patient is erect the greatest circumference is that of the hypogastrium.

When the patient is in the dorsal decubitus the umbilical circumference is greatest (measurements taken through the umbilicus anteriorly and the tip of the spine of the third lumbar vertebra posteriorly).

The umbilicus retains its normal central position (not elevated as with a gravid uterus or distended bladder). (Measurements are made from the umbilicus to the symphysis pubis and from the umbilicus to the sternoxiphoid junction.)

With the patient lying flat on the back the umbilicus also retains a central alignment (not displaced to the side as with ovarian cyst). (Measurements are made from the umbilicus to each anterior superior iliac spine.)

Horseshoe-shaped  
Area of Dullness

(2) *When the Accumulation is Moderate.* The distention is still symmetrical and tends to be globular or barrel-shaped when the patient is sitting or erect. When the dorsal decubitus is assumed, however, the flanks bulge while the central area of the abdomen appears flattened. To the typical fluid wave sign is added a second valuable phenomenon, i.e. that of shifting dullness (Fig. 59). (The level of the fluid in the flanks shifts as the patient turns to the side.) The suprapubic line of dullness, when the patient is in the dorsal decubitus, is curved with the concavity directed centralward (Fig. 60).

(3) *When the Accumulation is Slight.* If the fluid is minimal in amount it may be lodged entirely within the infracolic spaces as the patient lies flat, or in the pelvis as he sits

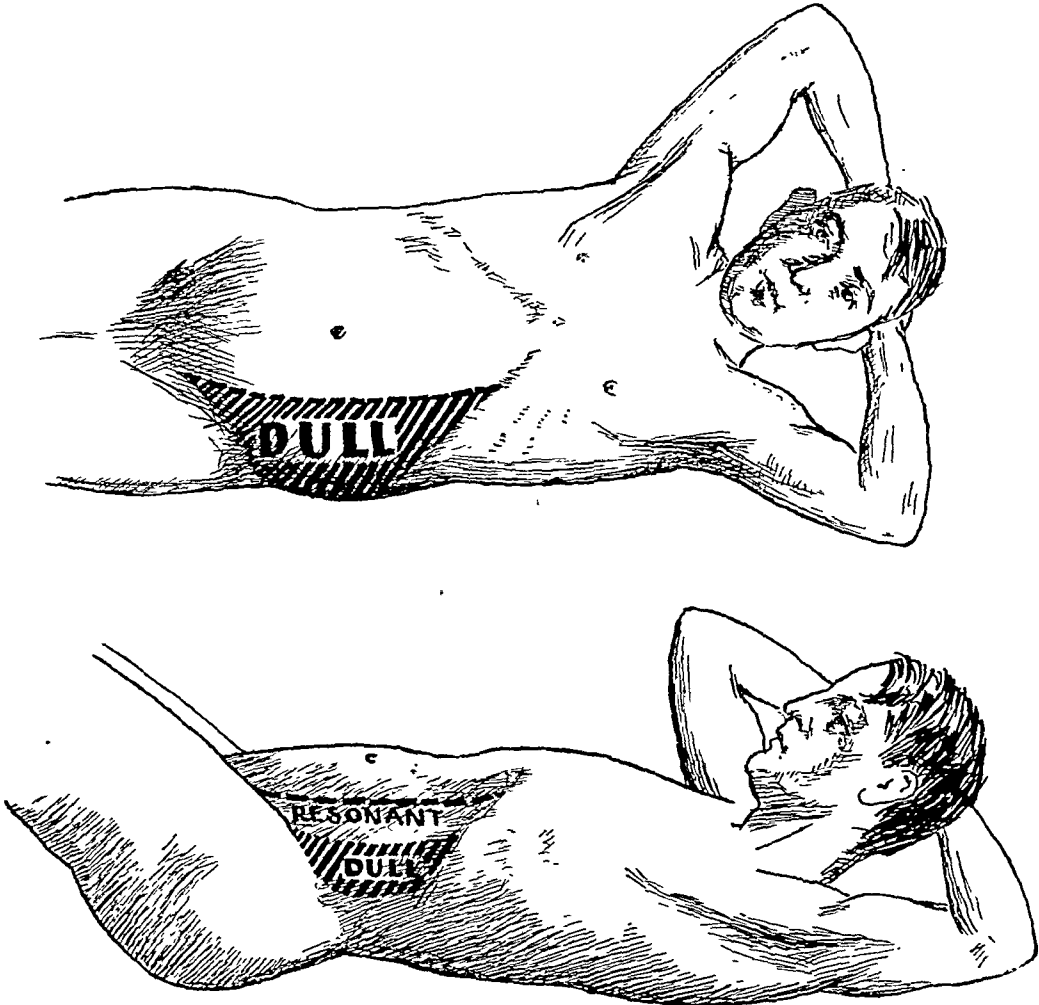


FIG. 59. Shifting dullness: evidence of free intraperitoneal fluid.

or stands. The inability to demonstrate small amounts of fluid is not absolute proof of the absence of free fluid from the cavity. The best means for detecting a small amount of fluid is to turn the patient well upon his side and attempt to demonstrate shifting dullness in the dependent flank or to place him, should his condition warrant, in the knee-elbow position and search for a flat or dull note about the umbilicus. The per-

cussion should be very light in character, for only by this method may a thin layer of liquid overlying tympanitic bowel (small amount in paracolic gutter) be detected.



FIG. 60.

A. Distention with ascites. Note distribution of fluid with central curved line of dullness.

B. Distention with ovarian cyst. Note that maximum distention is below the umbilicus and that there is no extension to the flanks. (From Douglas.)

*Special Rules.* In examining the abdomen for free fluid the following general rules should be borne in mind:

(1) The abdomen has not been completely examined until the posterior as well as the anterior wall has been palpated and until in the male the rectum and in the female both the rectum and the vagina have been explored digitally. By making rectal and vaginal examinations a routine part of an abdominal examination many diagnostic blunders may be avoided, and some of these blunders may be safely avoided in no other manner.

(2) The abdomen should be reexamined after catheterization, the administration of enemas, paracentesis, operations, or partial recovery under conservative treatment; questions may then be answered which could not be settled until the intra-abdominal pressure had been reduced.

(3) The examination of the abdomen alone is often insufficient; other parts of the body should also be studied before attempting a final diagnosis.

(4) Here as elsewhere the well-taken history is the safest guide to an accurate diagnosis and this should always be correlated with the findings upon local examination.

It is often easy to state the precise cause for the intra-peritoneal fluid but there will remain instances in which it will prove impossible, without entering the abdomen to perform an operation or autopsy, to name the primary condition with precision.

Most important of the special evidences of fluid are the signs of dipping, ballottement, shifting dullness, the fluid wave, venous engorgement, and reducible hydrocele.

The tests known as "dipping" and "ballottement" both depend upon the presence within the abdomen of some solid mass as well as free fluid. When an enlarged liver or a solid tumor lies beneath a layer of free fluid it may sometimes be palpated by suddenly pushing the tips of the extended fingers of the examining hand against the anterior or lateral abdominal wall (dipping). The mass is "bumped against" in a characteristic fashion; and as the fingers are withdrawn the fluid flows back again to cover the tumefaction (Fig. 61). Once felt this sensation will not be forgotten. It is a pathognomonic sign of fluid. The same sensation is gained in palpating the patella after compressing with the fingertips a prepatellar bursa moderately filled with a serous effusion. When, during an abdominal examination, an enlarged liver has been detected and a moderate amount of free fluid is thought also to be present, the demonstration of dipping after the patient has been placed in the Trendelenburg position proves the presence of the free fluid.

Dipping with  
Ascites



**Ballottement**

True ballottement (Fr., *balloter*, to toss up) is a sign used in the diagnosis of pregnancy. Here, with the tip of the fore-finger in the vagina a sharp tap is made in the lower segment

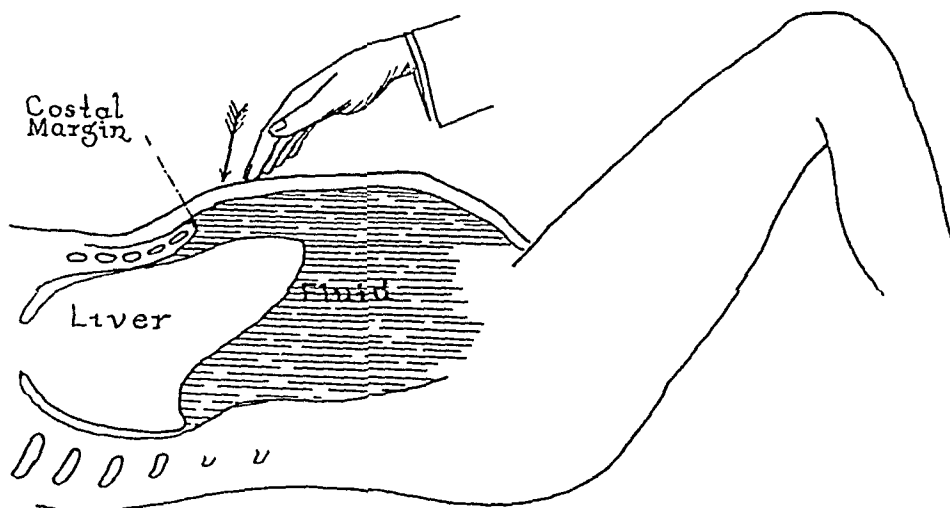


FIG. 61. "Dipping" with ascites. To palpate the liver: one quick jab in direction of arrow. (After Slade.)

of the uterus; the embryo, if present, is tossed upward and if the finger is retained in place will presently be felt to strike against the wall of the uterus as it falls back. Or, as the pregnant uterus is pushed against from the side, the fetus may be displaced within the amniotic fluid, only to float back and impart a gentle tap against the examining hand which has been held quietly in position. A solid mass, particularly if supplied with a pedicle will often impart the same sensation to the examining fingers as it floats back to an original position after being displaced.

**The Fluid Wave**

The fluid wave has been discussed with the mention of Pascal's law and of the inability to maintain a sustained tangential pressure through a fluid medium. The sensation experienced upon tapping against an ascitic abdomen (the abdomen then being by definition an elastic bottle) may be duplicated by tapping against a rubber waterbottle and detecting with the opposite hand the characteristic fluid wave. To make the fluid wave test as the patient is attempting to

rise without the use of his arms from the recumbent to the semirecumbent posture will enhance the ease of its detection.<sup>80</sup> This manoeuvre by contracting the abdominal muscles increases the pressure upon the ascitic fluid. By conducting the test after this special manner even small amounts of free intraperitoneal fluid may be demonstrated.

Shifting dullness is illustrated in accompanying photographs (Fig. 59). When the fluid is considerable in amount the shift of the line of flatness or dullness may be considerable, but the error is frequently made of expecting too great a shift when the amount of free fluid is small. So great is the capacity of the peritoneal cavity that the addition of even a quart of fluid to any given amount raises the total level but little as the patient lies flat upon the back. The repeated demonstration of even one fingerbreadth of shifting dullness constitutes reliable evidence of free fluid. It has been pointed out (Mayo-Robson) that when the free fluid consists of blood the shifting in the flanks takes place slowly, due to the fact that some of the blood is clotted and semigelatinous. Hence sufficient time should be allowed, when testing, for the complete shift to take place (in the case of blood a full minute) and when the shift is definitely demonstrated and proved to be unusually slow, the evidence points to a fluid which is thick and presumptively blood.

Shifting Dullness

The venous engorgement may be due to the same cause which is exciting the free fluid (retroperitoneal tumors, cirrhosis) or it may be due to the weight of the fluid alone as it presses upon veins such as the iliac, inferior vena cava, or those of the portal system. The typical caput Medusae has already been described. At times only a few longitudinal superficial veins or even a single vein may be seen upon the distended anterior abdominal wall (see Fig. 58). The vein or veins extend upward from the umbilicus, carrying blood which would normally be passing to the heart by way of the portal vein but now has come to the surface through the veins reaching the umbilicus along the round and falciform ligaments of the liver and by a collateral route is passing through the

Superficial Venous  
Engorgement

paraumbilical veins to reach the internal mammary veins or those associated with the diaphragm and ultimately the superior vena cava (Fig. 62). With obstruction to the inferior



FIG. 62.

1. Caput medusae after thrombosis of the inferior vena cava following typhoid fever. (From Quervain.) A. "Portal" collateral veins (liver). B. "Caval" collateral veins (inferior vena cava).

vena cava they may pass upward from the thighs, traversing the entire anterior abdominal wall to reach the heart from above, chiefly by way of the thoracoepigastric veins, to reach the superior vena cava through the axillary and subclavian veins. The veins of this latter route (Fig. 62) have been termed the "caval" veins (collaterals from the inferior vena cava). It has been pointed out<sup>81</sup> that when both sets of veins are involved, due to ascites associated with disorders of the liver (carcinoma, cirrhosis), a withdrawal of the ascitic fluid by

The "Caval" Veins

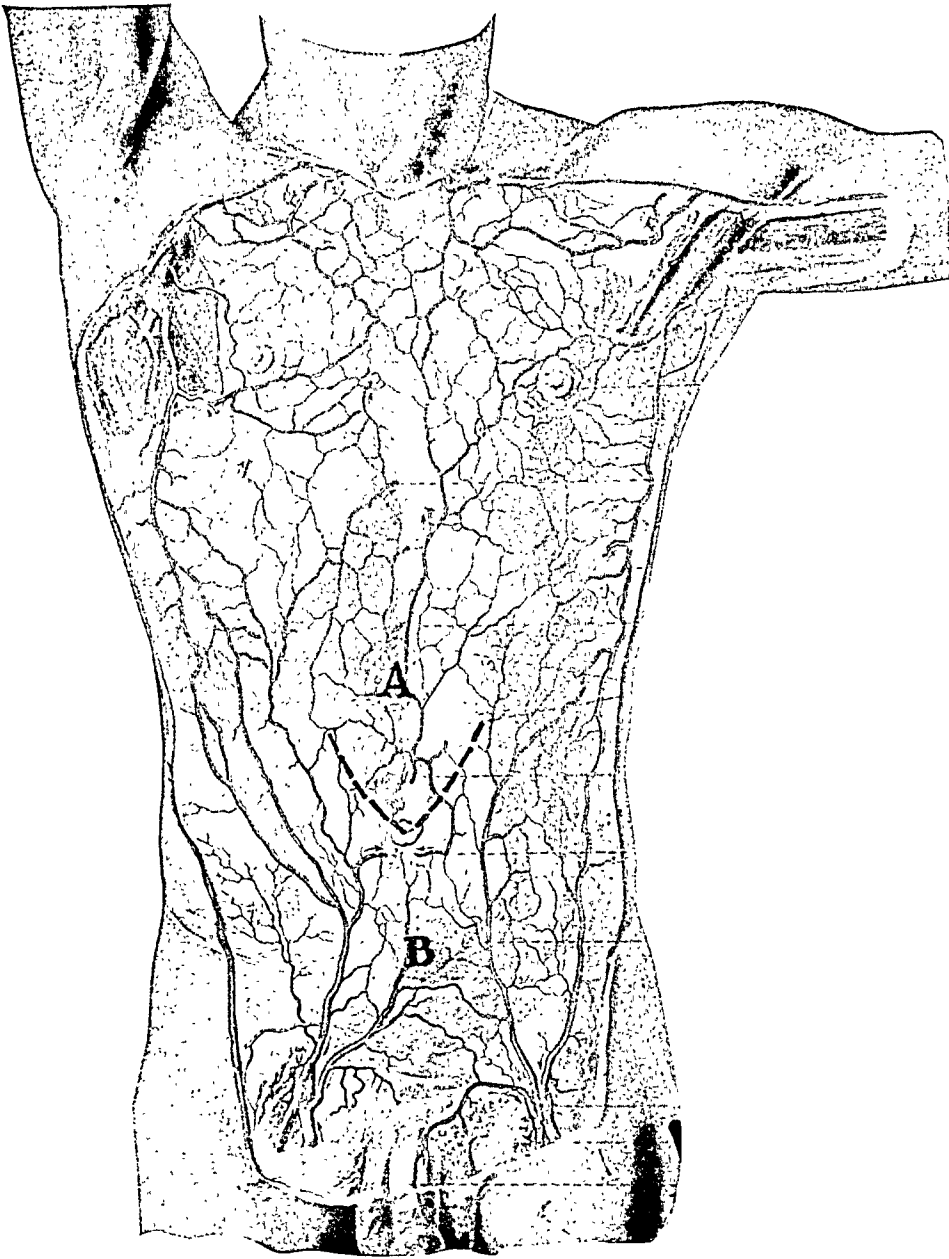


FIG. 62.

11. The superficial abdominal veins. A. "Portal group." B. "Caval group."  
(From Spalteholz.)

paracentesis, thus removing the weight from the inferior vena cava, may result in a disappearance of the caval veins while the portal collateral veins remain distended, thereby demonstrating the persistence of the obstruction to the portal vein by the primary pathological process.

Reducible  
Hydrocele

Ascitic and other free intraperitoneal fluids gravitate into prolongations of the peritoneal membrane (hernial sacs) when these are dependent in position. In the inguinal region such a condition is known as a reducible hydrocele. The presence of an open hernial sac may, indeed, prove a valuable aid in the demonstration, by appropriate posture, of a small amount of free fluid, and when the sac is otherwise empty the fluid, under strict aseptic precautions, may safely be withdrawn for identification.

4. DIFFERENTIATING THE CAUSES OF ABDOMINAL DISTENTION. It is usually though not always easy to distinguish free intraperitoneal fluid from other conditions causing abdominal distention. Aside from the positive methods of identification discussed, certain general "negative" evidence will prove of value.

*a. Distention due to fat* is characterized by a generalized thickening of the panniculus adiposus throughout the body (face, neck, extremities, buttocks); the abdomen retains its normal relative size to that of the thorax. The panniculus may be picked up between the fingers and the superficial nature of the condition demonstrated. It must be recalled, however, that with excessive subcutaneous fat there will also be a weakening of abdominal supporting walls due to fatty infiltration and that intra-abdominal fat also will be excessive. The suggestion of a fluid wave observed in the corpulent patient disappears as the "fat wave" is blocked by the margin of an assistant's hand pressed firmly against the linea alba. In some instances excessive fat and ascitic fluid will coexist within the abdomen, yielding distention of a dual nature.

*b. Distention due to flatus* tends to be localized, is associated with marked tympany and often with visible peristaltic waves

seen upon the anterior abdominal wall or initiated by flicking the abdomen with a moist towel or snipping it with the fingertips. When the large bowel is the seat of distention with gas,

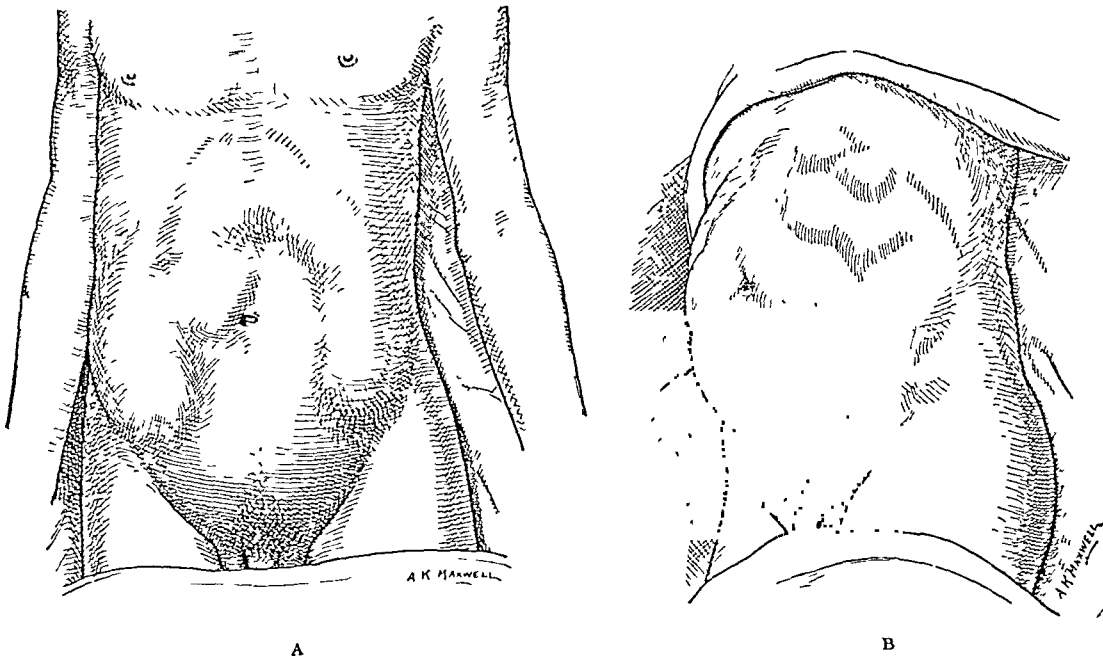


FIG. 63. Distention due to flatus.

- A. Diagram to show appearance of moderate distention of the large gut.
- B. Drawing to show ladder pattern of abdominal distention (indicating obstruction of the lower ileum). (From Cope.)

proximal to a rectal or sigmoid obstruction, the distention is found at the periphery of the abdomen (Fig. 63A). When the gas is restricted to small bowel the distention tends to be central in location and to display a typical "ladder pattern" (Fig. 63B). When the stomach is acutely dilated the swelling lies to the left of the midline and is umbilical or subumbilical in location while the epigastrium is largely uninvolved. The stomach pump or the rectal tube may prove of service in establishing the diagnosis.

c. *Distention due to feces* is nodular or patchy; the asymmetry is obvious; and the cause of the condition may be demonstrated by cleansing the gastrointestinal tract. Rectal

examination will often reveal impacted feces or some obstructive lesion in the lower bowel. A succussion splash may be obtained when gas and liquid coexist in colon or stomach.

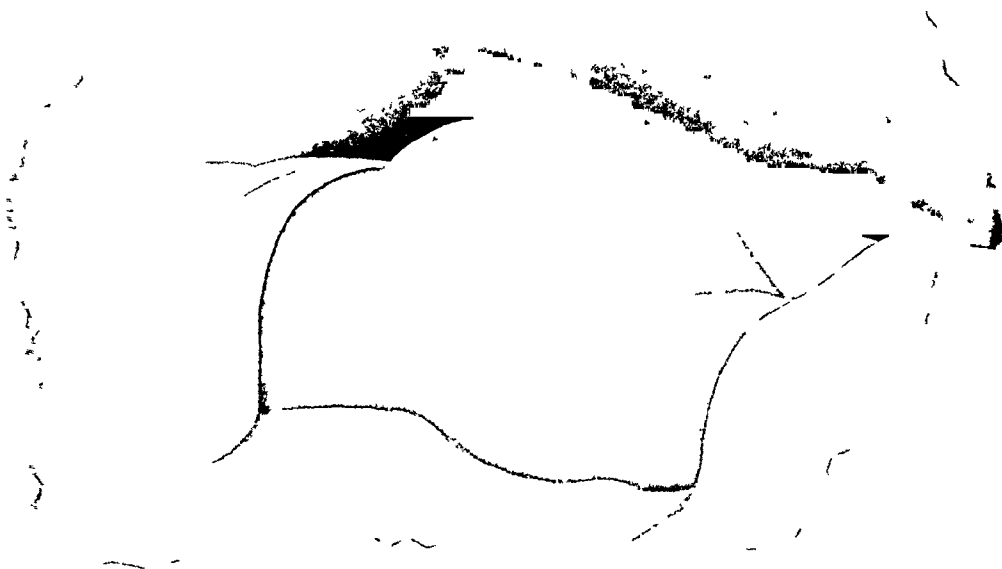


FIG. 64. Abdominal distention due to gravid uterus and distended bladder. (From DeLee's "Principles and Practice of Obstetrics." W. B. Saunders Co.)

*d. Distention due to a gravid uterus* should present little diagnostic difficulty. There is a history of the cessation of menses and the vaginal examination may reveal ballottement and softening or congestion of the cervix. Externally, fetal movements, fetal heart sounds, or a funic souffle often are detectable (Fig. 64). A fetus may be identified by a roentgenogram as early as the fifth month.

*e. Distention Due to Solid Tumors.* Solid tumors often cause or are associated with ascites. Means for identifying and differentiating various solid tumors are discussed elsewhere (section on the Solid Organs). When tumors are present, unassociated with ascites, the distention tends to be asymmetrical; dullness is lacking in the flank, the presenting mass

has form as well as size; it may be movable or move spontaneously with respiration; and its surface and consistency may serve to identify the swelling. With intra-abdominal malignancies there may be enlargement of the left supraclavicular gland (so-called Troisier or Virchow-Troisier gland).

*Distention due to localized collections of fluid* tend to displace the umbilicus upward, downward, or lateral; although the mass is dull the flanks are tympanitic; no typical shifting is observed; the swelling is usually ovoid in form and can often be easily outlined. Distended bladder disappears with catheterization (see Fig. 64), the hydronephrotic tumor tends to vary in size, in association with a history of polyuria; the ovarian cyst springs from or begins in one side and frequently may be identified by the pelvic examination.

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## EPONYM

## RUTHERFORD MORISON

- Eponym :** Morison's space.
- Nativity :** Hutton Henry, Co. Durham, England.
- Birth :** October 10, 1853. Living surgeon.\*
- Connections :** Consulting surgeon, War Pensions Hospital.  
Late examiner in Surgery for Liverpool and Edinburgh Universities.  
Emeritus professor of surgery, Durham University.  
Consulting surgeon, Royal Victoria Infirmary, Newcastle-upon-Tyne.  
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1875. M.B.  
1879. F.R.C.S. Edinburgh.  
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- Source of Eponym :** The anatomy of the right hypochondrium, relating especially to operations for gall stones. *Brit. M. J.*, Nov. 3. 1894.
- Other Writings :** An Introduction to Surgery.  
Contributions to Surgery (2 Vols.).  
Abdominal Injuries.  
Bipp Method of Wound Treatment.  
Abdominal and Pelvic Surgery for Practitioners.  
Articles: Aneurysm, varicose veins, varicocele. Abscesses in connection with the vermiform appendix. *Lancet*, 1901. Indications for operation; treatment of general peritonitis. *Brit. M. J.*, 1911.
- Reference :** Who's Who (Engl.), 1929.
- \* Present address: St. Boswells-on-Tweed. Complete life sketches are not attempted in instances where the person signified by the eponym is still living.

SIXTY-SECOND ANNUAL MEETING;  
OF THE  
**BRITISH MEDICAL ASSOCIATION.**

Held in BRISTOL July 31st, and August 1st, 2nd, 3rd.

PROCEEDINGS OF SECTIONS.

SECTION OF SURGERY.

W. MITCHELL BANKS, M.D., F.R.C.S., President.

THE ANATOMY OF THE RIGHT HYPOCHON-  
DRIUM RELATING ESPECIALLY TO OPER-  
ATIONS FOR GALL STONES.

By RUTHVENFORD MORISON, M.B., F.R.C.S.,

Senior Assistant Surgeon, Royal Infirmary, Newcastle-on-Tyne.

THE purposes of my paper are: 1. To draw attention briefly to the anatomy of the parts concerned in the surgical treatment of gall stones, with the object of demonstrating that a pouch exists behind the right lobe of the liver which has natural barricades separating it from the general peritoneal cavity. 2. To suggest that efficient drainage of this pouch is likely to serve a useful purpose in gall stone operations.

If the abdomen be opened in the right linea semilunaris, the sharp lower border of the right lobe of the liver, with frequently the fundus of the gall bladder, will be seen resting against the transverse colon. If the edge of the liver be drawn upwards and the colon downwards, a space, previously potential, is exposed (Fig. 1). The roof or anterior wall which has just been opened up is not sealed. It looks forwards and to the right. From right to left it is formed by the peritoneum covering the diaphragm, the under surface of the right lobe of the liver, and the gall bladder, and not unusually is completed internally by a fold of the gastro-hepatic omentum continued to that viscus.

The floor is formed by the ascending mesocolon covering the kidney, duodenum, and other structures lying on the posterior abdominal parietes (Fig. 1). Superiorly the space is bounded by the right lobe of the liver. Inferiorly by the ascending layer of the transverse mesocolon (Fig. 2), covering the duodenum internally. Externally by the peritoneum lining the lumbar parietes as far down as the iliac crest. Internally by the peritoneum covering the spine behind, the free edge of the gastro-hepatic omentum in front, and the foramen of Winslow between the two (Fig. 3).

This pouch can be effectually drained by an opening made through the posterior parietes immediately below the lower end of the kidney, for the remaining dependent part is occupied by the right end of the right lobe of the liver. A varying quantity of fluid, roughly a pint, may be introduced into the pouch from below before any overflow into the general peritoneal cavity can take place. The fol-

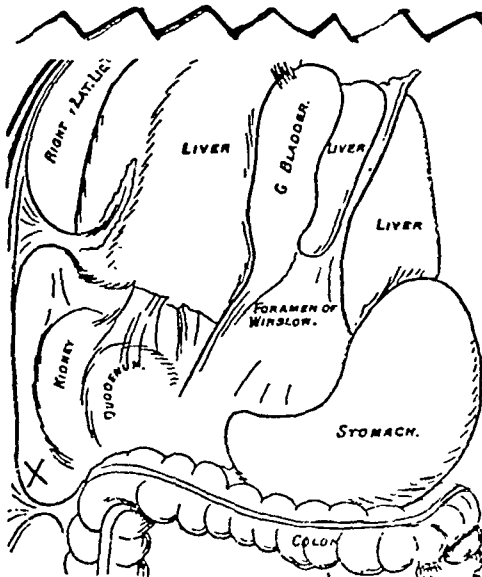


Fig. 1.—The pouch described shown by drawing liver upward. x in all the figured marks points for drainage.

CONCLUSIONS.

A pouch exists below the right lobe of the liver and gall bladder separated from the general peritoneal cavity by natural barriers. This pouch can be efficiently drained through an opening in the parietes near the lower end of the kidney. A transverse is better than a vertical incision in operating for gall stones; less likely to be followed by ventral hernia and giving free access. Biliary fistula results from operations for gall stones in a considerable percentage of cases in which the gall bladder has been attached by sutures to the parietes. The method of attachment has little to do with this result and it may follow when the ducts are patent. The gall bladder and ducts may safely be allowed to empty into the pouch described, if it is properly drained. The gall bladder should never, except when suppurating, be stitched to the abdominal wall. If the pouch is properly drained (a) when the gall bladder is distended, the opening in it should be closed by sutures and the viscous returned into the abdominal cavity and the drain left until the certainty of its successful closing is complete. b. When the gall bladder is shrunken and there is difficulty in closing the opening made in it, it may be returned unclosed. c. When a stone is impacted in the cystic duct and evades all ordinary efforts to remove it the gall bladder should be excised and the duct ligatured after removing the stone in it. d. When a stone is impacted in the common duct, the duct is incised and after the stone or stones are removed the opening may be left unclosed if there is any difficulty in applying a satisfactory suture.

FIG. 65.

## EPONYM

## SIR ARTHUR WILLIAM MAYO-ROBSON

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 1888. Lecturer on operative surgery, Leeds.  
 1890-1900. Professor of surgery, Yorkshire College, Victoria University.  
 1897. President, Gynaecological Society.  
 1893-1909. Member of Council R.C.S.  
 1900- Honorary president, Surgical Section, 13th. Internat. Medical Congress, Paris.  
 1902-5. Vice-President, R.C.S.  
 1905. Bradshaw lecturer, R.C.S.  
 1906. Surgeon, Dreadnought Hospital.  
 1917-19. Consultant, War Office.  
 Consulting surgeon from 1902, Medical School, Leeds.  
 Consulting surgeon to Batley and Keighley Hospitals.  
 Inspector of Military Orthopaedic Hospital.  
 Honorary consulting surgeon, King Edward VII Memorial Hospital, Windsor.  
 Honorary Fellow, Am. Surg. Soc.; Honorary Member, Soc. de Chir., Paris; Honorary Member, Royal Soc. de Med. de Ghent.  
 F.R.C.S.; Knight of Grace, Order St. John of Jerusalem; Chevalier de la Legion d'Honneur.
- Source of Eponym:** The Pancreas; Its Surgery and Pathology. Phila., Saunders, 1907.
- Other Writings:** On Gallstones and Their Treatment.  
 Diseases of the Gall Bladder and Bile Ducts.  
 Diseases of the Stomach and Their Treatment.  
 Diseases of the Pancreas.  
 Cancer and Its Treatment.
- Reference:** Who's Who (Eng.), 1929.
- \* Present address: Broadoak, Seale, Surrey, England. Complete life sketches are not attempted in instances where the person signified by the eponym is still living.

# THE PANCREAS

## ITS SURGERY AND PATHOLOGY

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ILLUSTRATED

PHILADELPHIA AND LONDON

W. B. SAUNDERS COMPANY

1907

(c) *Pain and Tenderness.*—These symptoms, although important when present, are so variable that even their complete absence is no proof that the pancreas is normal. Both pain and tenderness are, as a rule, absent in malignant disease of the head of the pancreas, but in exceptional cases of carcinoma and sarcoma of the head, body, or tail the pain may be excruciating. This is due either to pressure on, or involvement of, the great sympathetic ganglia, or to pressure on, or invasion of, neighbouring viscera, particularly the stomach and duodenum. Small scirrhous tumours are, as a rule, characterised by absence of pain, while large growths are often marked by constant and extreme agony. In the various forms of pancreatitis pain and tenderness in the epigastrium are generally well marked. The more acute inflammations are characterised by excessive tenderness on pressure, the presence of a tender spot just above and to the right of the umbilicus, rigidity of the recti, and pain of an agonising character. The pain in hæmorrhage into the pancreas is intermittent, being at times severe and of a colicky character, then diminishing or disappearing, to return later with increased intensity. In chronic pancreatitis pain and tenderness, although usually present, may be but little marked. In

ness are pronounced. Calculus of the pancreas may exist for years undetected, and unsuspected, without causing any pain. If, however, the calculus reaches the orifice of the pancreatic duct, or is impacted in the ampulla of Vater, severe paroxysmal pain, resembling a gall-stone seizure, will occur and be associated with jaundice. As to the character of the pain, it may be continuous or paroxysmal, and may be limited to the epigastrium or radiate around either side of the thorax. Pain in the back, under the left scapula, or between the scapulae, is more frequent than pain beneath the right scapula in pancreatic disease, thus serving to distinguish it from gall-bladder pain. "Coeliac neural-

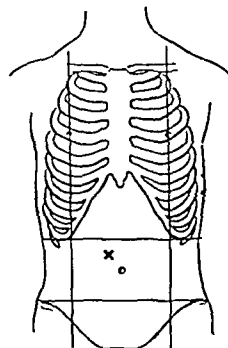


Fig. 173.—Most frequent site of the tender spot in inflammatory affections of the pancreas.

FIG. 66.

[173]

SUPPLEMENT: A. J. S., n. s. Vol. VIII, No. 4, p. 947

## EPONYM

## CHARLES ÉMILE TROISIER

<b>Eponym :</b>	Troisier's gland; Virchow-Troisier gland.
<b>Nativity :</b>	Ardenne, France.
<b>Birth, Death :</b>	1844-1919.
<b>Connections :</b>	1879. Staff physician, Hôpitaux de Paris. 1880. Chief-of-staff, Hôpitaux de Paris. Services at Teuon, La Pitié, Lariboisière, Beaujom. President, Société Médicale des Hôpitaux de Paris. 1901. Elected member of the Académie de Médecine.
<b>Education :</b>	1869. Interne, Hôpitaux de Paris. 1874. Medical degree. Thesis: Cancerous Pulmonary Lymphangitis (Prize Essay).
<b>Source of Eponym :</b>	Les Ganglions Sus-claviculaires dans le Cancer de l'Estomac. <i>Bull. et mém. Soc. méd. d. hôp. de Par.</i> , Année 1886.
<b>Discussion of Eponym :</b>	While it has been known since the time of Virchow that a tumefaction of the supraclavicular ganglia might be caused by cancer of the stomach, Troisier made a most complete study of the subject and showed that the adenopathy might occupy either side of the neck or both sides at once, but that the left side was the favorite site. He showed also that the left supraclavicular gland involvement might be due to any abdominal cancer whatever (pancreas, liver, kidneys, uterus, testicles, ovaries). From the time Troisier wrote his medical thesis the subject of cancer of the lymphatic glands and vessels was "dearest to his heart," and he wrote many articles concerning his researches in this field.
<b>Other Writings :</b>	Supraclavicular adenopathy in abdominal cancers. <i>Arch. gén. d. méd.</i> , 1: 129-139; 297-309, 1889. Supraclavicular, inguinal, and axillary adenopathy in a case of cancer of the ovary. <i>Bull. et mém. Soc. méd. d. hôp. de Par.</i> , s.3, 3: 501-502, 1888. Cancer of the thoracic duct. <i>Ibid.</i> , 14: 302-314, 1897.
<b>References :</b>	<i>Presse méd.</i> , 28: 33-35, 1920. <i>Bull. d'Acad. de méd.</i> 82 (s.3, 2): 490-491, 1919.

#### A TRANSLATION OF THE FIRST OF A SERIES OF PAPERS BY TROISIER RELATIVE TO ENLARGED SUPRACLAVICULAR GLANDS WITH INTRA- ABDOMINAL CANCER

##### THE SUPRACLAVICULAR GLANDS IN CANCER OF THE STOMACH

It is well known that cancer of the esophagus and that cancer of the lung are rather often propagated to glands of the lateral and inferior parts of the neck and this localization is justly considered as a valuable sign for the diagnosis of a cancer within the thoracic cavity. It must not, however, be believed that propagation to the supraclavicular glands occurs only in cancer of the esophagus at its upper part and in cancer of the pleura or of the lung. I propose to prove that it exists in cancer of the stomach. I do not need to state that this propagation is absolutely exceptional.

When M. Charcot was president of the Anatomic Society, I had often heard him say that Henoch in his "Clinique des maladies du bas-ventre," had pointed out propagation of cancer of the stomach to the glands of the supraclavicular cavity (see in particular the Bulletin of the year 1876, page 460). Thus it is that my attention was drawn to this point and since that time I have never neglected to look for this propa-

# BULLETINS-ET MÉMOIRES

DE LA

## SOCIÉTÉ MÉDICALE

DES

### HOPITAUX DE PARIS

TOME III — TROISIÈME SÉRIE

ANNÉE 1886



PARIS

G. MASSON, ÉDITEUR

LIBRAIRE DE L'ACADÉMIE DE MÉDECINE

120, BOULEVARD SAINT-GERMAIN

1886

373

SÉANCE DU 8 OCTOBRE 1886

Présidence de M. Guyot.

INHAIRAL. — Correspondance. — Des ganglions sus-claviculaires dans le cancer de l'estomac. M. TROISSE. — Note histologique du foie support. Diagnostic. Tuberculose pulmonaire probable. M. CÉTOT (Discussion). MM. A. OLLIVIER, E. LAROT, MILLARD, BÉRENGER. — Flections.

Le procès-verbal de la précédente séance est lu, mis aux voix et adopté.

#### CORRESPONDANCE IMPRIMÉE

Journal de médecine et de chirurgie pratiques. — Annales des maladies de l'oreille et du larynx. — Gazette de gynécologie. — Progrès médical. — Gazette des hôpitaux. — France médicale. — Tribune médicale. — Journal d'hygiène. — Le Praticien. — Revue de thérapeutique médico-chirurgicale. — Marseille médical. — Lyon médical. — L'Union médicale du Nord-Est. — Loire médicale. — Revue médicale de Toulouse. — Gazette médico-chirurgicale de Toulouse. — Bulletin médical du Nord. — Société de médecine d'Angers. — Nouveau lauréat médical. — Revue mensuelle d'hydrologie pyrénéenne. — Bulletin de l'Académie royale de médecine de Belgique. — Compte rendu de la Société de biologie. — Bulletins de la Société anatomique. — Archives de médecine et pharmacie militaires. — Recueil des travaux du Comité consultatif d'hygiène de France, t. XX.

LES GANGLIONS SUS-CLAVICULAIRES DANS LE CANCER DE L'ESTOMAC, par M. TROISSE, agrégé, médecin de l'hôpital Saint-Antoine.

I. On sait que le cancer de l'œsophage et que le cancer du poulmon se propagent assez souvent aux ganglions de la partie initiale et inférieure du cou, et l'on considère à juste titre cette localisation comme un signe précieux pour le diagnostic d'un cancer de la cavité thoracique. Il ne faudrait pas croire cependant que la propagation aux ganglions sus-claviculaires ne puisse se rencontrer que dans le cancer de l'œsophage et sa partie supérieure et dans le cancer de la plèvre ou du poulmon. Je me propose de prouver qu'elle existe dans le cancer de l'estomac. Je n'ai pas besoin de dire que cette propagation est tout à fait exceptionnelle.

Lorsque M. Chirac était président de la Société anatomique, je lui avais

souvent entendu dire qu'Hennoch, dans sa *Clinique des maladies du bas-ventre*, avait signalé la propagation du cancer de l'estomac aux ganglions du creux sus-claviculaire (voy. en particulier les *Bulletins* de l'année 1874, p. 160). C'est ainsi que mon attention a été attirée sur ce point, et depuis cette époque je n'ai jamais négligé de rechercher cette propagation. Bien que je n'en aie que trois exemples, j'espère que le fait vous paraîtra suffisamment démontré.

III. Avant de tirer des conclusions des observations qui précèdent, je tiens à citer les rares auteurs qui ont signalé l'altération des ganglions sus-claviculaires dans le cancer de l'estomac.

Voici comment s'exprime Hennoch à ce sujet (*Klinik der Unterleibs krankheiten*, 1863, p. 307) : « Le diagnostic de cancer de l'estomac est plus certain quand on peut trouver des ganglions durcis au-dessus de la clavicule... » A l'appui de cette remarque, Hennoch cite (p. 311) l'observation d'un malade qui mourut d'un cancer de l'estomac, et à l'autopsie, « immédiatement au-dessus de la clavicule gauche se trouvaient deux ganglions jugulaires, mous, ayant le volume d'un uf de pigeon et la consistance de la pierre. »

Dans une clinique publiée en 1875 (*Berliner klinische Wochenschrift*, t. 1), Friedreich insiste à propos du diagnostic du cancer de l'estomac sur la présence d'une tumeur ganglionnaire dans le creux sus-claviculaire. Chez le malade qui faisait le sujet de cette leçon, « la fosse sus-claviculaire gauche était remplie par un piquet de ganglions tuméfiés, durs, indolores, atteignant pour quelques-uns les dimensions d'une noisette. »

On trouve le passage suivant dans le traité de Leube (*Die Krankheiten des Magens und Darms*, in *Handbuch... von Ziemssen*, t. VII, 1876, p. 127) : « Un indice des plus certains de l'existence d'un cancer de l'estomac que la simple cachexie, c'est la tuméfaction des ganglions lymphatiques périphériques, avant tout de ceux de la région sus-claviculaire (Virchow). Toutefois, elle manque assez souvent et peut naturellement tenir à d'autres causes. »

Comme on le voit, Leube attribue à Virchow, et non à Hennoch, le mérite d'avoir mentionné cette altération des ganglions cervicaux dans le cancer de l'estomac. Je ne sais ce qu'il y a de fondé dans cette assertion ; j'ai vainement recherché cette mention dans le *Traité des tumeurs*.

IV. Les faits que je viens de vous communiquer me paraissent démontrer que le cancer de l'estomac peut, exceptionnellement il est vrai, se propager aux ganglions du creux sus-claviculaire. Il semble même résulter de ces faits que :

1° La propagation du cancer de l'estomac aux ganglions du creux sus-claviculaire est une preuve de généralisation du cancer, mais avec un point d'élection ; et ce qui me surprend, ce n'est point la distance qui sépare les ganglions de l'organe primitivement lésé, ce n'est pas l'absence d'altération des ganglions ou des organes intermédiaires, c'est l'absence d'altération des ganglions lymphatiques périphériques, avant tout de ceux de la région sus-claviculaire (Virchow). Toutefois, elle manque assez souvent et peut naturellement tenir à d'autres causes.

En terminant, je tiens à vous remercier de la discussion sur les cancers latents et les pseudo-cancers que j'ai ouverte, j'ai pensé que vous écouteriez avec intérêt cette modeste contribution à l'étude du cancer de l'estomac.

FIG. 67.

[175]

SUPPLEMENT: A. J. S., n. s. Vol. VIII, No. 4, p. 949

gation. Although I have only three examples I hope that the fact will seem to you sufficiently established. . . .

iii. Before drawing conclusions from the preceeding case reports, I am anxious to mention the few authors who did call attention to the alteration of the supraclavicular glands in cancer of the stomach: Henoeh (*Klinik der Unterliebs-krankheiten*, 1863, page 307); Friedrich (*Berliner klinische Wochenschrift*, Number 1 for 1874);—Leube (*Die Krankheiten des Magens und Darms in Handbuch . . . von Ziemssen*, Vol. 7, 1876, page 127). Leube attributes to Virchow and not Henoeh the merit of having mentioned this alteration of cervical ganglion in cancer of the stomach. I do not know how much truth there is in this assertion; I have vainly sought mention of this in the *Treatise on Tumors*. . . .

iv. The facts that I have just communicated to you seem to me to prove that cancer of the stomach may, exceptionally it is true, be propagated to the glands of the supraclavicular cavity. It even seems to follow from my three case reports and from the two cases reported with some details, one by Henoeh, the other by Friedrich that this secondary alteration of the glands affects particularly the left side of the neck. That is a proof of the spread of cancer, but with a favorite point; the thing that surprises me is not the distance that separates the glands of the organ first attacked, is not the absences of alterations of the gland, or of the intermediate organs, but is this very unusual localization in the supraclavicular cavity.

In closing may I be permitted to state that diagnosis should take advantage of this anatomic fact. As the discussion on latent cancers and pseudo cancers is still open, I thought that you would hear with interest this modest contribution to the study of cancer of the stomach.

#### QUESTIONNAIRE

1. What are the chief causes of abdominal distention?
2. What fluids may invade or accumulate in the peritoneal cavity?
3. What is the derivation of the word ascites?
4. What is an exudate; a transudate?
5. What is Clark's sign; Toma's sign?
6. What is a watershed; a drainage basin; a catchment basin?
7. Name the four chief drainage basins in the peritoneal cavity.
8. What are the boundaries of these basins?
9. What is the supracolic division of the abdomen; what organs are contained in this region?
10. Divide the peritoneal cavity into ten drainage basins or fairly definite spaces in which pus or other fluids may accumulate. Give the boundaries of each space.
11. Illustrate the manner in which these various basins communicate with one another.
12. Explain how changes in position effect liquid accumulations within the peritoneal cavity.
13. What is the mesentery of the small intestine; what is its length; its direction?
14. Describe the attachment of the roof of the mesentery.
15. Upon which side of the peritoneal cavity are collections of pus and blood most frequently encountered? Explain.
16. Describe the transverse mesocolon; to what is it attached?
17. Into what divisions does it separate the peritoneal cavity?
18. What is the length of the transverse colon; its normal position in the abdomen; its relations to the stomach?
19. What is meant by Morison's space?

20. What is the subhepatic space?
21. What organ or organs may perforate into the subhepatic space?
22. Bound Morison's space.
23. What is the hepatorenal pouch?
24. Bound Petit's triangle.
25. Describe the methods for inserting a drain into the hepatorenal pouch.
26. What is the right infracolic space? Its boundaries?
27. What is the left infracolic space? Its boundaries?
28. Describe the pouch of Douglas.
29. What is the best manner in which to displace loops of small bowel in order to examine the right infracolic space; the left infracolic space?
30. What is the duodenojejunal angle; its location?
31. Describe several methods by which to drain the pelvis.
32. Describe methods for draining an appendectomy wound.
33. Describe drainage after cholecystectomy; repair of perforated peptic ulcer; after operation for acute pancreatitis.
34. Describe methods for securing dependent drainage for the pelvis; for Morison's space; the left infracolic space.
35. What is the space of Retzius?
36. What is meant by stab wound drainage?
37. What are the advantages and disadvantages of employing stab wounds for bringing drains to the body surface?
38. Define dropsy, hydrops, anasarca, edema, hygroma, exudation, effusion, fluid, ascites.
39. Name some of the basic laws regarding fluids which prove of special interest to the diagnostician.
40. What is Pascal's law; Archimedes' principle?
41. Describe the important findings upon inspection, palpation, percussion and mensuration, in an abdomen markedly distended with ascitic fluid.
42. What are the best tests for detecting small amounts of free fluid within the peritoneal cavity?
43. What is meant by ballottement?
44. What is meant by dipping with ascites? Describe the technic for eliciting this sign and state its significance.
45. What is meant by the fluid wave sign?
46. Give methods for detecting the fluid wave with ascites.
47. What is meant by shifting dullness?
48. Why does free fluid within the peritoneal cavity shift but slowly with postural changes?
49. What veins of the anterior abdominal wall become distended with obstruction to the portal vein?
50. What veins of the anterior abdominal wall become distended from obstruction to the inferior vena cava?
51. What is meant by the "caval veins?"
52. What is a reducible hydrocele; its significance?
53. How may abdominal distention due to ascites be differentiated from that due to fat? from that with accumulations of feces and gas?
54. Differentiate hydroperitoneum from ovarian cyst; distended bladder; hydronephrosis.
55. What is the appearance of the abdomen with marked gaseous distention of the large bowel; of the small intestine?



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No. 5

## PYOGENIC AND NON-PYOGENIC KIDNEY INFECTION

FROM A PATHOLOGICAL STANDPOINT\*

CHARLES Y. BIDGOOD, M.D., F.A.C.S.

HARTFORD, CONN.

IT IS not an uncommon experience in the practice of urology to encounter such a case as the following, which is presented in brief summary in order to illustrate one finding:

CASE I. C. R., admitted to the Hartford Hospital June 13, 1927, on the service of Dr. G. Gardiner Russell, temperature 100.8°F. Complaint: pain in the right side. Examination revealed an enlarged, tender right kidney. The voided urine contained a moderate amount of pus. Cystoscopic examination revealed a normal bladder. Ureter catheterization demonstrated no obstruction. Phenol-sulphonephthalein given intravenously showed appearance time, right kidney, three minutes; left kidney, three minutes; secretion, right side 9 per cent, left side 11 per cent, in thirty minutes. Urine obtained from each kidney was sterile to culture. A few days later a large perinephritic abscess was evacuated by Dr. A. M. Rowley. Culture of the pus showed *Staphylococcus aureus*.

The point to be demonstrated in this case is that sterile urine may be secreted by a kidney which is the site of a staphylococcus infection of sufficient intensity and duration to result in a perirenal abscess.

In contrast to this, is the common finding of chronic infections of the kidney and pelvis caused by organisms of the colontyphoid group without severe damage to the kidney or great harm to the patient, and it is the purpose of this report to

demonstrate the pathological condition which may ultimately result from an untreated colon infection of the kidney with continuous good drainage of the pelvis, in comparison with the end result seen in the above case, a coccus infection, in similar circumstances.

CASE II. Mrs. R. L., age forty-two, was admitted to the Manchester Memorial Hospital December 3, 1928, complaining of pain in the left back.

*Present Illness.* Onset six months before admission to the hospital. At that time the patient first noticed a dull, dragging pain in the left side, most noticeable at the end of an active day. This pain was located in the left back and side and radiated downward towards the groin and leg. It has never been acute and she has had no attacks simulating kidney colic. Four months before admission to the hospital she began having an occasional slight chill, followed by profuse sweating which would cease after a few hours. She thinks that she has been having a slight fever in the afternoon and evening during this time, because she has felt warm and her skin has been flushed. For the past three months it has been necessary for her to get up at night to void three or four times, and during the day she has voided about every hour and a half. There has been no dysuria, no hematuria, no urgency. During the past month her pain has become more constant and more severe. It has been located definitely over the left lumbar region, and the patient has noticed on palpating her side that a mass was present there.

\* Read before the New York section of the American Urological Association, November 27, 1929.

*Past History.* Except for the present illness the patient has been a normal, healthy woman. A review of the eye, ear, nose and throat,

lous and there are numerous striae. On inspection, respiratory movements are found equal and normal on each side. On palpation no

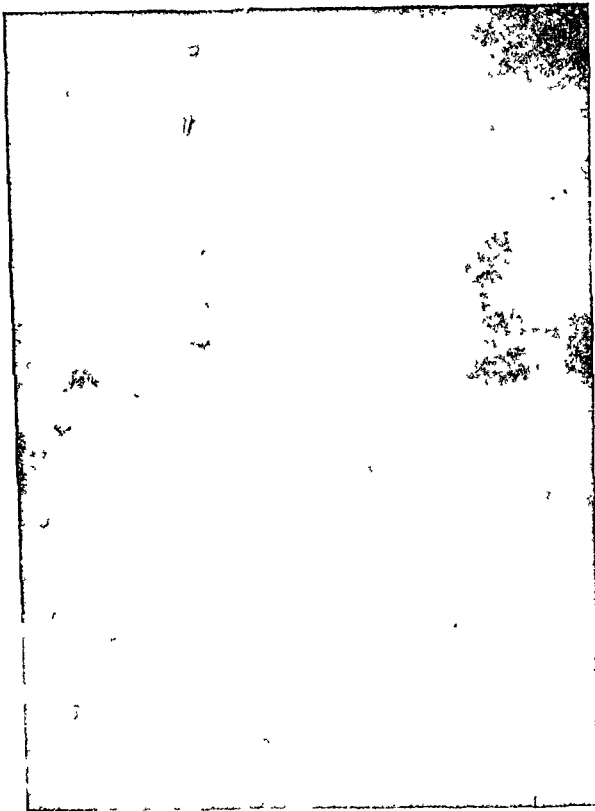


FIG. 1.

cardiorespiratory, gastrointestinal and nervous systems is negative; also the urinary tract up until the present illness.

*Personal History.* The patient has had ten children, all normal labors. Nine are living and well, one died in infancy. No miscarriages. Menstrual history: periods have always been regular and normal, no bleeding between periods. Family history negative for tuberculosis, cancer, etc.

*Physical Examination.* The patient is a well developed, well nourished, adult female, forty-two years old, lying quietly in bed, apparently in no pain. Temperature 99°F., pulse 85, respiration 20, hemoglobin 95 per cent, red blood corpuscles, 4,400,000.

Examination of the eyes, ears, nose, mouth, throat normal; thorax and lungs normal; cardiovascular: heart not enlarged, apex beat is in the fifth interspace within the nipple line. Pulse 80, regular, good quality. Blood pressure 130/70. Extremities normal, reflexes normal.

*Abdomen.* The abdomen is slightly pendu-

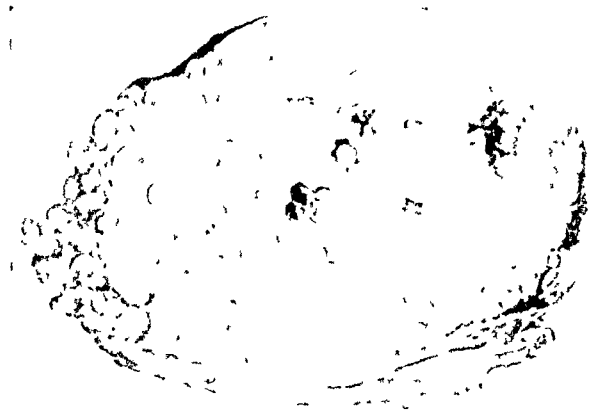


FIG. 2.

epigastric tenderness is found, no masses. No tenderness, masses or muscle spasm felt in the right flank or costo-vertebral angle. No suprapubic tenderness, bladder not distended. In the left flank and costovertebral angle a large mass is felt. This is found to be well up underneath the ribs and to extend almost to the mid-line anteriorly and downward as far as the crest of the ileum. It is slightly irregular on palpation; it does not fluctuate; it descends on inspiration; it is moderately tender, and there is definite muscle spasm in the costovertebral angle. Catheterized urine shows a large amount of pus and a stain smear shows many Gram negative bacilli. The specific gravity is 1020; reaction acid, sugar and diacetic acid, negative.

*Cystoscopy.* The cystoscope enters readily and shows cloudy urine in the bladder. Bladder capacity 450 c.c. On inspection the entire bladder mucosa shows a diffuse catarrhal inflammation. No ulcers, tumors, stones seen. No diverticula. The trigone is slightly reddened and granular. Both ureteral orifices are normal in size and contour, but the left orifice is reddened and there is seen coming from it long shreds of inspissated pus. Clear urine is being secreted from the right side. No. 6 catheters ascend to each kidney without meeting any obstruction, and clear urine is obtained from the right side, and very purulent urine from the left. Intravenous phenolsulphon phthalein shows the appearance time on the right side five minutes; secretion 25 per cent, in thirty minutes. On the left side no phenolsulphon phthalein appeared in thirty minutes.

Microscopic examination of the urine obtained from each kidney shows the urine from the right kidney to be free from pus, and a stain smear showed no organisms. On the left side the urine contained a large amount of pus, and a stain smear showed many colon bacilli. Culture of the urine for twenty-four hours showed the right side to be sterile and the left side to contain many colon bacilli.

*X-ray Report* (Dr. D. J. Roberts, Roentgenologist):

The stereoscopic x-ray examination of the urinary tract before and after the injection of each kidney pelvis shows the right kidney outline to be somewhat enlarged, with normally filled pelvis, calices and ureters. The left kidney outline is not well defined. Throughout the region of the lower calices on the left side there are poorly defined semi-opacities suggesting debris or calcareous changes in the kidney substance. Following injection of this side the kidney shows a marked deformity and disintegration, the general appearance suggesting multiple abscess formations, the major and minor pelves appearing considerably contracted. The ureter, while it is slightly enlarged throughout its lower two-thirds, is otherwise negative in appearance.

*Roentgen Conclusions.* Marked disintegration of the left kidney cortex with contractures of the major and minor calices, and calcareous deposits in the kidney substance (the general appearance compatible with advanced tuberculous changes).

*Final Diagnosis.* Chronic colon bacillus infection of the left kidney, with a functionless kidney.

*Operation.* The patient was placed in the usual kidney position and an incision made beginning at the costovertebral angle and extending downward and anteriorly to a point opposite the anterior superior spine of the ileum. The external and internal oblique muscles and transversalis were divided and the perirenal fascia exposed. This was opened and the perirenal fat exposed. Digital examination failed to reveal any line of cleavage between the perirenal fat and kidney, the entire kidney having been completely destroyed and replaced by scar tissue. It was therefore necessary to remove the perirenal fat with the mass. This was done, all fibrous bands being doubly clamped, divided and ligated.

The tissues at the upper and lower pole were similarly treated until the entire mass, includ-

ing the perirenal fat, was free. The ureter was isolated below the mass, doubly clamped, divided and ligated. The pedicle was triply clamped, divided and doubly ligated. In so doing a small vessel of the pedicle was made to bleed slightly, but was quickly caught and ligated. Two rubber tissue drains were inserted into the depth of the wound and the muscle layers closed with a mattress suture of No. 2 chromic catgut. The skin was closed with fine silk.

The patient's condition at the end of operation was entirely satisfactory.

Following operation the patient had an uneventful convalescence and was discharged from the hospital three weeks later with the wound completely healed, and the urine free from infection.

*Pathological Report of Specimen Removed* (Dr. Ralph Kendall, Pathologist):

*Macroscopic examination:* The specimen consists of an oval fibro-fatty mass, weight 858 gm., measuring  $15 \times 9 \times 8$  cm. At one side a tube-like structure is seen which has the appearance of a thickened ureter. On section the bulk of tissue shows ordinary fat lobules separated by increase in fibrous tissue. At the center of the mass there is more dense gray white fibrous tissue, not sharply outlined, but roughly kidney-shaped, and through which are seen small cavities filled with white purulent material. The ureter can be traced into one of these cystic areas before it reaches this space. However, it passed through a dense, rather fibro-fatty tissue.

*Microscopic Examination:* The renal parenchyma is completely destroyed and replaced by a dense and cellular fibrous tissue through which occasionally are seen a few distorted tubules or rare glomerulus. The latter shows a marked dilatation of the capsular space. Throughout the entire tissue there is a marked round and plasma-celled infiltration frequently arranged as lymphoid follicles. Beneath the epithelium of the pelvis there is a massive round-celled and polymorphonuclear cell reaction. There is no evidence of tuberculosis. At the outer margin, the capsule of the kidney cannot be identified from the marked fibrosis of the parenchyma. There is, however, a thick layer of fatty tissue at the surface.

#### DISCUSSION

When any parenchymatous organ is invaded by bacteria, the resulting patho-

logical process is determined by a combination of circumstances: the dosage and virulence of the organism, the degree of immunity of the host, and the efficiency of drainage. The first two of these are considerations in any infection; but the last, drainage, is of particular importance, because by it, more than any other local factor, is the ultimate life or death of the organ determined.

When one speaks of drainage in kidney infections, the usual conception conveyed is drainage of the kidney pelvis. But it is believed by several investigators, such as Dyke, that drainage within the kidney parenchyma, particularly at the inception of the infection, is the basis upon which rests the correct explanation of the fact that different types of organisms, notably those of the colon typhoid group, and the pyogenic cocci, often yield dissimilar pathological processes.

To be more explicit, there is an opinion among investigators that organisms belong to the colon typhoid group show a predilection for that portion of the kidney which has its origin in the Metanephros, namely the ureter, pelvis and collecting tubules, that portion of the secretory mechanism which is efferent to the glomerulus; while the cocci, according to the experiments of Dyke, are disposed to lodge as emboli in the vessels afferent to the glomerulus. If this theory be acceptable, it would follow that in the latter location there would be no opportunity for drainage into the renal pelvis, the glomerulus serving as a barrier, and for lack of this drainage, abscesses would result, located chiefly in the cortex and boundary zone of the kidney. This, we know, is the clinical picture frequently seen in staphylococcus infections. It is conceivable that such lesions might heal spontaneously; but it is more often true that once inaugurated, the infection will progress, ultimately terminating in a kidney studded with multiple confluent abscesses. If the lesion is confined to only a part of the kidney, to a localized area of miliary abscesses, the

so-called "carbuncle of the kidney" results. If the abscesses rupture into the pelvis of the kidney and there is interference with pelvic drainage, pyonephrosis will result, and if the rupture occurs through the cortex, a perinephritic abscess.

With infections due to the bacteria of the colon-typhoid group, the pathological picture is different from that described here. This group of organisms never results in multiple disseminated abscesses of the kidney parenchyma, perinephritic abscess, or "carbuncle of the kidney," because, being efferent to the glomerulus, drainage is allowed.

The likelihood that the above hypothesis may be true has considerable support clinically. With regard to coccus infections, it is the not common experience of all urologists to encounter suppurative lesions of the kidney with multiple parenchymatous and perinephritic abscesses, usually staphylococcus in origin, with sterile urine being secreted by the infected kidney. This would indicate that the site of the infection is such that it cannot drain into the kidney pelvis, and since it is reasonable to assume that if the infection were efferent at the glomerulus, at least some drainage would occur, it follows that the infection must be afferent to it, and that the glomerulus forms a barrier to drainage. Experimentally, the recent work of MacKenzie and Hawthorne shows that intravenous injections of colloidal particles in sufficient dosage, causes blocking of the capillaries of the glomeruli, and the intertubular capillaries which, if permanent, ultimately causes infarct formation.

In contradistinction to this is the common experience that in the majority of simple, acute and chronic infections of the kidney due to organisms of the colon-typhoid group, recovery is the rule without serious renal damage, if there is efficient pelvic drainage, probably because the infection attacks primarily that portion of the kidney efferent to the glomerulus.

This difference is also supported by statistics. Cabot and Crabtree's analysis

of a series of kidney infections reveal focal suppurative lesions to be the rule in 27 cases of coccus infections, with cortical abscess in 20 of them. In their studies of lesions produced by the colon-typhoid group, they found no cases presenting the same condition when pelvic drainage was good, and their studies of sections stained for bacteria showed the presence of bacilli in the collecting tubules to be the rule. In their conclusion they say: "we believe that lesions produced by cocci and pyogenic bacilli differ essentially from the lesions produced by the non-suppurative organisms, chiefly the colon-typhoid group."

#### CONCLUSIONS

The theory presented here is not original in this paper, but is based largely upon the

experimental work of Dyke, and is used as a working basis for the explanation of clinical differences often seen in coccus and bacillary infections of the kidney.

The case demonstrated represents an instance of autonephrectomy caused by an untreated colon bacillus infection. It is presented because we believe that it typifies the final pathological picture which may result if such infections are allowed to progress without therapeutic interference.

[For discussion see p. 964.]

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# SURGERY OF THE FIBROUS PROSTATE

## AN OPERATION FOR TOTAL EXCISION OF THE GLAND\*

E. GRANVILLE CRABTREE, M.D., F.A.C.S.

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THE trend in urological surgery seems to me to be definitely away from uniformity in operative measures to be applied to obstructing lesions of the prostate gland. Many surgeons aim to approach the prostate by that operative procedure best adapted to the type of gland encountered. There seems to be an increasing number of surgeons employing both the suprapubic and the perineal approaches for prostatectomy. Early advocates of the suprapubic operation often held themselves purists, and did not ever depart from their conviction as to the superiority of the suprapubic route. Cancers, fibrous contractures, and large adenomata received similar treatment at their hands. Perineal operators lived up to their ideals with equal fervor and dragged large benign intravesical prostates through the perineum. Perusal of the literature on prostatic surgery of an earlier day indicates combative exposition of one method of approach to the exclusion of the other. In spite of this combative attitude both operations have survived on their merits. The fact remains that the great majority of obstructive prostates are operable with low morbidity and mortality by either method of approach.

A few years ago, on reviewing the end-results of operations for fibrous prostates in my own cases and those of other surgeons which happened to pass through my hands, I found a higher morbidity than average in patients suffering from fibrous glands. The type of lesions encountered were roughened prostatic cavities, tight internal sphincters, urethras contracted through the prostatic bed, an occasional non-catheterizable patient, and others with continued symptoms in spite of operation, and persistent infection. A

few of these patients had been operated on more than once in the hope of improving the end-result. The group of patients represented the combined efforts of eight surgeons. It was easy to see that the fibrous prostate offered by no means so good a prognosis as benign hypertrophy. It was with the hope of producing better results that I began to do total prostatectomy on this type of case. It is my purpose to submit in this communication the end-results of a group of 15 cases operated upon in this manner. It was my intention to do an occasional case by this method until sufficient time had elapsed to determine the value of the surgical measure before adopting it as routine.

In discussing total excision of the fibrous prostate, I do wish to discredit in any way the cautery operations devised by Caulk, Collings and others for prostatic bars. The work of these pioneers in this type of work is most praiseworthy. I believe such electrocautery procedure should be encouraged in every case to which the operation is applicable. However, since in many fibrous prostates a bar does not constitute the whole of the obstruction, but a shrunken atrophic gland is itself capable of offering resistance to voiding; since intraurethral impingement of small nodules of hypertrophy from lateral lobes often exist together with bar formation; since fibrosis may exist without bar formation; and dilatation of the atrophic fibrosed gland is an unsatisfactory means of maintaining free drainage in an old man who wants cure of his condition, a group of cases suitable for a more radical treatment than the cautery is constituted. It is with this group that I have concerned myself in performing total removal of the prostate gland.

\* Read before the American Urological Association (N. Y. Branch), November 27, 1929.

I had for some time been employing total prostatectomy by the perineal route in suitable cases of carcinoma of the

formed a certain number of suprapubic dissections of fibrous glands. I do not believe these have been nearly so satis-

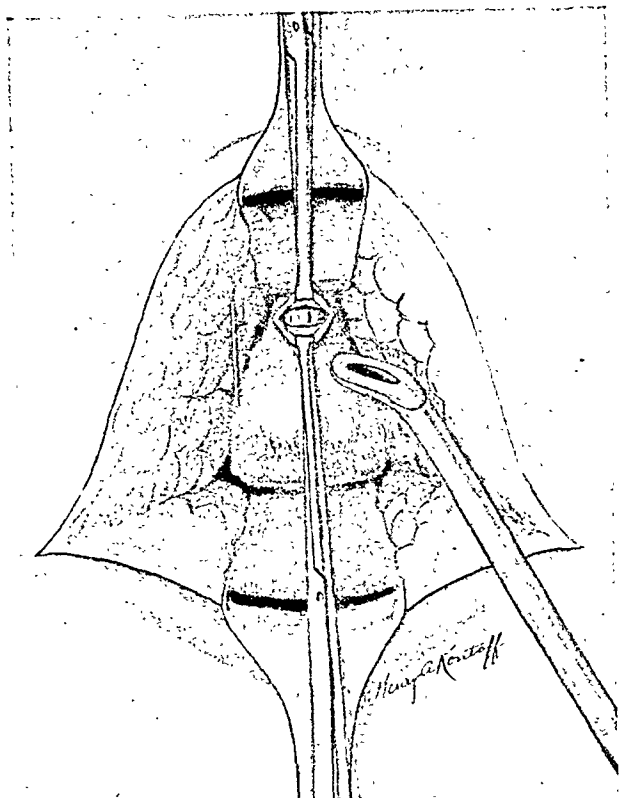


FIG. 1. Central tendon and rectourethralis muscle divided; membranous urethra exposed. Transverse incision into urethra at apex of prostate upon sound. Prostate tractor ready for insertion.

prostate and those suspected of carcinoma, because I felt that it gave me an opportunity to do a more extensive operation

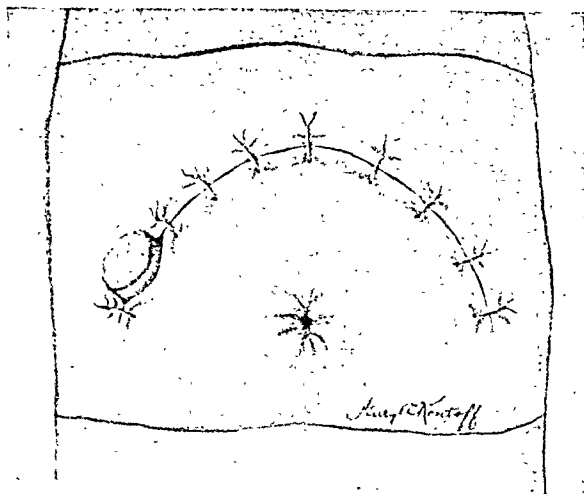


FIG. 2. Suture of perineal wound and drain in place. and still leave the patient with less damage as a result as shown in incontinence or damaged function. I had also per-

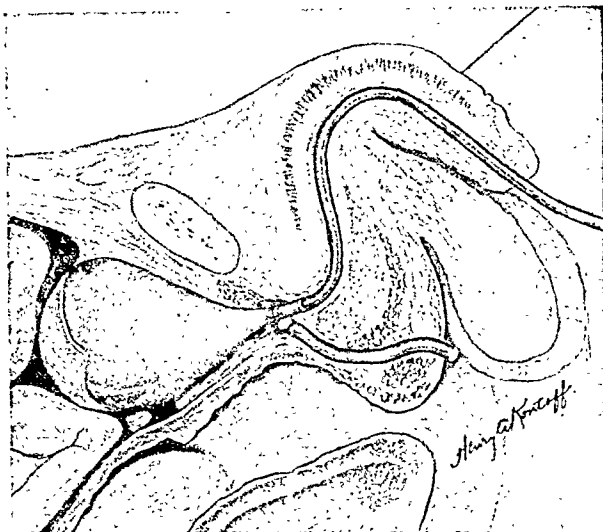


FIG. 3. Sagittal view after removal of prostate. Soft rubber catheter in urethra and drain in place.

factory as those operated on by the method of total prostatectomy which I shall later describe in detail. In transvesical dissections I found that I was not obtaining as smooth a cavity and was apt to find portions of prostate left near the membranous urethra, that is, the tip of the prostate and at the bladder neck. These irregularities gave obstruction, perhaps not greatly noticeable immediately

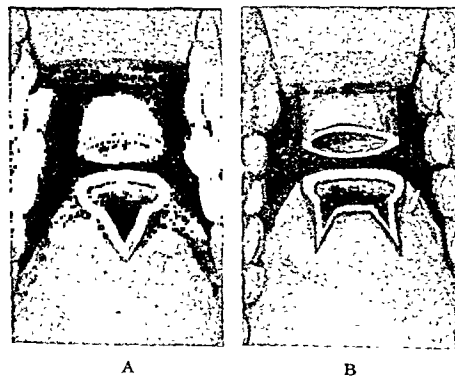


FIG. 4. Midline incision in posterior neck of bladder so that when sutured to urethra, floor of bladder is on line with urethra and there is no sagging of trigone.

after the operation but occasioning considerable trouble some months later. In addition I have found that suprapubic operations for the fibrous glands are, in my hands, not nearly so easy technically as the operation through the perineum. I



therefore abandoned the suprapubic approach in favor of the perineal operation.

In preliminary preparation of these

diverticulum a suprapubic drain was placed, and the patient allowed to continue on that drainage until the perineal

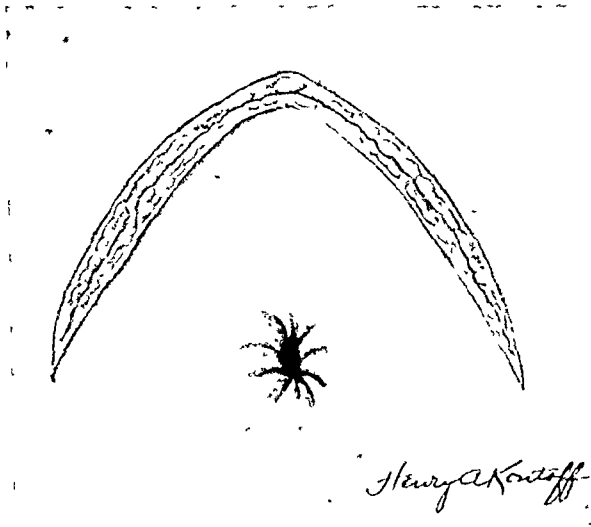


FIG. 5. Perineal incision used for prostatectomy.

patients drainage was accomplished by the urethra in some, by suprapubic cystotomy in others, and in a third group by combined urethral and suprapubic drainage. In making the choice of drainage to which the patient was subjected, the urethral type was used in those patients in whom a short period of drainage preparation was all that was required. The majority of the patients preferably had suprapubic drainage by cystotomy. It is my impression that by suprapubic drainage prostatic congestion is diminished, the patient bleeds less at operation, and on the whole the bladder is in better condition at the time of the subsequent operation on the prostate. Where calculi are present suprapubic drainage is of course preferable to urethral drainage. In still a third group of cases, particularly those in which diverticulum was encountered as a complication to the fibrous prostate obstruction, combined urethral and suprapubic drainage was employed. Greater ease in handling the bladder pathology through a primary wound was the basis for decision in favor of urethral drainage previous to the operation for diverticulum. At the time of operation for

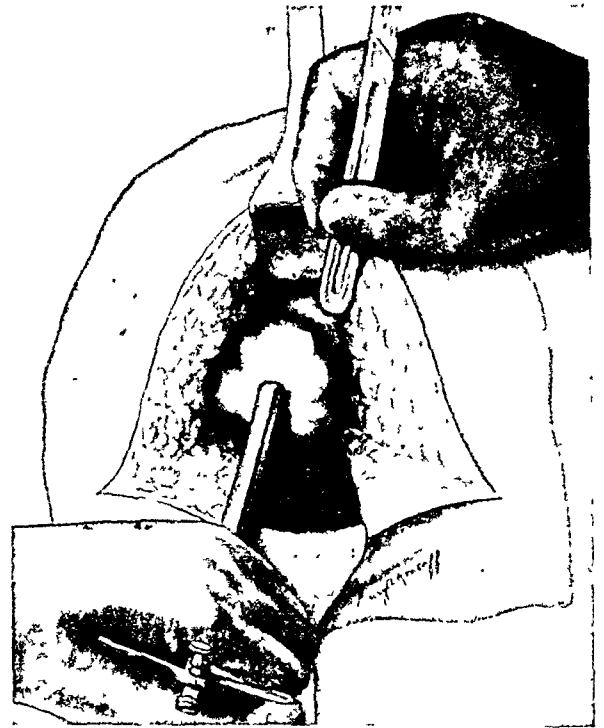


FIG. 6. Tractor opened out and prostate drawn down. Prostate, en masse, being dissected free from surrounding tissue by handle of knife.

operation was completed. In a few cases urethral drainage was not well tolerated and suprapubic drainage was established immediately.

Bilateral vasoligation was done in all cases as a preliminary to prostatic operation. While vasoligation is not a 100 per cent guarantee against testicle complications in prostatic obstruction, it so diminishes the morbidity from this disease that it is well worth while. I have been unable to detect any systemic change in the patient as the result of this procedure. Except by reference to the patient's history, I do not believe I can distinguish between those patients in whom vasoligation has been done and those in whom it was not a part of the prostatic operation. The time at which vasoligation is done is at the institution of drainage in those cases in which urethral drainage is employed, and at the time of suprapubic

cystotomy in those instances where suprapubic drainage is used. In those patients in whom the period of urethral drainage was short, ligation of the vas was sometimes done at the time of the prostatic operation. In others where diverticulum complicated the operation for prostatic obstruction ligation of the vas was done at the time of the operation for diverticulum. Vasoligation has proved to be a boon to the prostatic patient and a source of great comfort to the surgeon, and I have no doubt, has saved the lives of a few cases that were narrowly balanced and in which a severe degree of epididymitis has seemed to be the deciding factor which finally caused the loss of the patient's life.

#### DESCRIPTION OF THE OPERATION EMPLOYED

With the patient in the lithotomy position, an inverted U perineal incision was made and carried down to expose the central tendon of the perineum. The tendon was severed and the prostate exposed freely by reflecting the posterior layer of the membrane of Denonvilliers. Transverse section of the membranous urethra at the tip of the prostate was then made on a sound in the urethra, and Young's perineal retractor inserted into the bladder. At this point complete section of the membranous urethra can be made. By means of blunt dissection and sharp dissection wherever necessary the gland is readily exposed upon the bladder wall. By slightly increasing the traction on the perineal tractor the prostatic urethra can be opened at the internal orifice on the retractor as a guide. A smooth internal orifice can be provided with curved operating scissors by dissecting away the prostate from the bladder wall. Tenaculum forceps are then inserted into the internal prostatic orifice and the gland turned outward after the perineal tractor has been removed. By gentle traction and blunt dissection the gland can be sufficiently elevated to allow separation of the ejaculatory ducts with curved scissors.

All bleeding points can be snapped and tied at this point to insure a dry wound. Inasmuch as the fibrous gland is a small

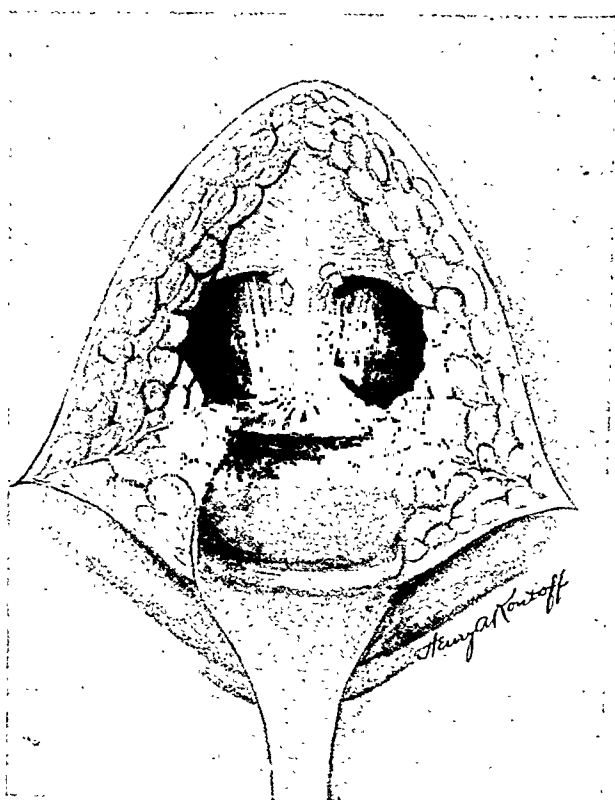


FIG. 7. Space opened on each side of central tendon by fingers.

gland, the distance separating the bladder neck from the severed urethra is never great, and sufficient slack is obtained by traction on the bladder to easily approximate the bladder neck and the severed urethra. A large urethral catheter, as large as the urethra will permit, is then passed into the bladder and the bladder neck sutured to the urethra over this catheter. This forms a complete mucous membrane connection between the severed urethra and the bladder. If care is taken, sufficient prostatic urethra can be left to allow of the resuturing being done without greatly altering the position of the internal vesicle sphincter. A small perineal drain, usually of rubber dam or Miller wicking, or a light gauze pack can be placed, and the wound closed without further drainage. It has been my experience that with an open wound and the opportunity to ligate all bleeding points a rubber dam drain is

used much more effectively than the gauze pack. Bleeding has in no case been excessive and seldom has there been

supplementary incisions will be best seen by reference to the illustration. As will be noted by reference to the tables on end-

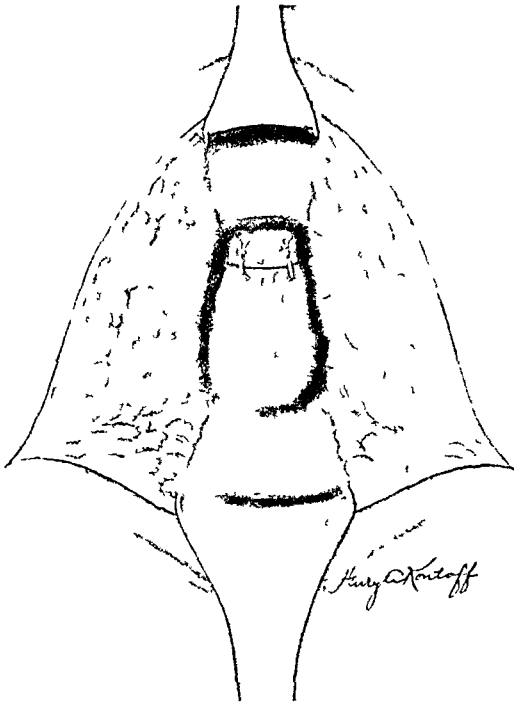


FIG. 8. Anastomosis of neck of bladder with stump of membranous urethra with interrupted chromic catgut.

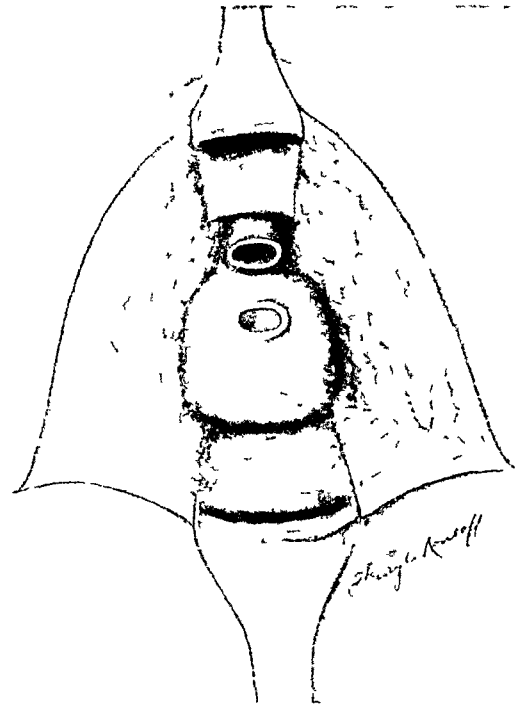


FIG. 9. Prostate removed, showing opening at neck of bladder and cut end of membranous urethra.

more than a slight discharge of serous fluid. Rarely is there any leakage of urine through the perineum. Where the bladder base is not flattened by removal of the prostate, two procedures have been employed to accomplish this aim. The first of these is as follows:

A v-shaped excision is made in the posterior lip of the bladder orifice in such a way as to lower the posterior margin of the bladder orifice to the level of the bladder floor. (See Fig. 4A.) As near an approximation as is possible is then made so that the severed urethra may close this opening. Such enlargement of the bladder neck is usually too great for the urethra to close it entirely. These patients may leak some urine through the perineum in the course of convalescence. In the other procedure, two lateral incisions are made to produce a lip on the posterior surface of the internal orifice, which lip is sutured to the severed end of the urethra. (See Fig. 4B.) The nature of these two

results in these cases, there is no evidence that such enlargement of the internal sphincter increases the tendency to incontinence or decreases the function of the bladder. I am convinced that flattening of the bladder base is an important procedure particularly in those cases of contracture in which the internal orifice of the bladder is greatly elevated above the position of the ureters in the bladder. As has been already mentioned this is not always a necessary procedure for most often, removal of the prostate sufficiently flattens the bladder base to make such an incision unnecessary. As one might expect in those cases in which gauze packing of perineal wounds, or insertion of bags for hemastatic control is not indicated, the patient's convalescence is extremely comfortable, drainage and sutures are removed within a few days, and the perineal incision heals by first intention. Where suprapubic drainage has been employed it is usually removed at the time of operation, but the

TABLE 1

Date	Age	Cystot.	Cath.	Other Path.	Drainage Days	Post Op. Return of Func.	Condition in 1929			
							Living	Pus in Urine	Satisfactory Function	Resid. Urine
1924	58	X			12	14 days	X	o	X	o
1924	73	X			19	20	X	o	X	o
1925	53	X		Diver-ticulum	64	3	X	X	X	o
1925	59	X			22	20	X	o	X	o
1925	68	X			10	21	X	o	X	o
1926	71	X		Stone	7	30	X	o	X	o
1926	72	X		Stone	29	?	X	o	X	o
1926	66		X		14	16	X	o	X	o
1927	58		X		13	14	X	o	X	o
1928	69		X	Diver-ticulum	13	9	o	..	..	..
1928	54	X			9	9	X	o	X	o
1928	79	X			57	11	X	o	X	2 oz.
1928	55		X		31	12	X	X	X	o
*1929	69		X	Small stones	10	10	X	o	X	o
*1929	68		X		18	9	X	o	o	o

Average 14 days

\* Six months post op.

suprapubic tube can be left indefinitely. I have made no provision for retaining the urethral catheter other than the usual adhesive tape fixtures applied to the penis for this purpose. Since bleeding from the prostatic cavity is not apt to enter the bladder because of the suture line which excludes it, drainage from the bladder is usually clear from the beginning and gives no trouble whatever. I do not know the fate of the vesicles where the ejaculatory ducts have been severed, but it is reasonable to suppose that with ligation of the vas atrophy takes place. At any rate, neither in the course of convalescence nor subsequently have we encountered any difficulty whatever with the vesicles which have been excluded from their normal urethral drainage.

I wish it to be clearly understood that I claim nothing original about the type of operation performed in this small group of cases. As you will see by reference to the drawings, Young's operation for total excision of the prostate for carcinoma has been adapted to the fibrous gland, to which adaptation this operation is particularly well fitted. I wish you to look upon this group of cases as an experimental

group and to remember that I have but slowly developed it in order to give sufficient time to determine the final end-results as to function in these cases before doing a larger series. I feared that the scar tissue formation about the prostatic cavity might be sufficient to cause contraction of the prostatic urethra to a degree in excess of that which usually takes place following any type of prostatic removal. It is only since I have satisfied myself that such contraction had not taken place, following my review of those cases, that I have been willing to adopt the operation, but have not included the latter cases in the list given in Table 1. The end-results of the two operations seem to be equally satisfactory.

Postoperative return to function averages for the group of 15 cases, fourteen days, with 7 cases in the neighborhood of ten days. It was rare that urine leaked through the perineal incision at all, and equally rare that blood complicated drainage in any degree whatever following operation. The comfort of the patient was distinctly noteworthy. There was no operative mortality. One patient, satisfactorily convalescent, returned to the

hospital after a period of stay-at-home and died of pneumonia. His chief handicap at the time of operation was emphysema of the lung. There was but one case in which the functional result was not entirely satisfactory. That patient showed some dripping for a period of four months, but has since entirely recovered. In one other case a two-ounce residual persists. The urine has entirely cleared from pus and bacteria. This was noted at the end of a year and six months following the operation. The patient entered the hospital in uremia having had a long-standing over-distention with a very thick bladder wall showing extensive fibrosis. After a preliminary preparation of fifty-seven days, the perineal operation was done. I do not believe the type of operation influenced the persistence of residual, but rather that it represents the condition of the bladder.

#### DISCUSSION OF PAPERS BY DRs. BIDGOOD AND CRABTREE

DR. BENJAMIN S. BARRINGER: Dr. Bidgood's paper was of great interest to me, but I am confident that I will have to read it over carefully to see why cocci attack the cortex and colon bacilli the pelvis of the kidney. I confess that I do not understand this, though I know that both Dr. Crabtree and Dr. Bidgood consider this to be the case. I should like to hear Dr. Bidgood's explanation.

The results shown by Dr. Crabtree's operation are most extraordinary. I fear (even though I may be alone in such a statement) that if I took 15 of my best prostatectomy cases and measured the residual after operation, I would find at least one-half of them with one dram to one-half ounce. Possibly it might not exist, and perhaps the amount is exaggerated; but I am quite sure that probably 13 out of the 15 would show residual. His extraordinary results in this direction was the first thing which struck me in considering his operation. If he can get such good function in a condition which has puzzled all of us for a good many years, I think we should adopt this operation ourselves.

DR. BARRINGER: I cannot precisely follow Dr. Crabtree's technic, because fibrous prostates do not dissect out bluntly in my hands, probably because they are done suprapubically and I do not know how to do this

There has been no occasion for any reoperative measures of any kind whatever. The urethras are uniformly smooth, admit a sound or cystoscope freely, and show a functioning internal urethral sphincter. I believe this type of operation has a definite place in prostatic surgery for a selected group of cases lying between those where satisfactory relief can be obtained by cautery or punch operation, and the typical prostate, a benign hypertrophy, which is treated either by the suprapubic or the perineal route by enucleation. It affords satisfactory end-results in a group of patients in which they have been least satisfactory. In addition it appears from the results as tabulated in this group of cases, the oldest of which is five years since operation, to prove that the operation affords a permanent and adequate relief of symptoms.

perineal operation. I want more than anything I have heard of lately to see him perform the operation, and see what I can make out of a heretofore puzzling condition.

I am a poor one to discuss this subject, because for years I have advocated no operation for various conditions of the sort, such as carcinoma of the prostate, conditions of the trigone and of the bladder neck, etc. The less operating, the better, has been my opinion, having in mind the patient's condition rather than the operation itself. That is nothing against what Dr. Crabtree has said, however.

At any rate, I think it is time I saw Dr. Crabtree do his operation, as his results are even more extraordinary than would at first appear when we consider how bending-over-backwards he is in the matter of accuracy in recording end-results, checking up statistics, and the like.

DR. THOMAS J. KIRWIN: Dr. Crabtree's paper has, it seems to me, defined with acuteness a problem over which controversy has been waged for a generation. I have listened to discussions of this character by urologists whose leadership in the profession is a matter of common consent. It has occurred to me that after all has been said the controversy represents no real differences of principles. Nobody denies that irrespective of method or

technic, the chief objective of any prostatectomy is preservation of the sphincters without injury to the rectum or the ejaculatory ducts. Fundamentally, then, the question is whether that objective may be more successfully reached suprapubically or perineally. As you all realize, of course, the situation is perplexed by practical considerations in individual cases. Dr. Keyes only last week made us the beneficiaries of his long experience when he read before the Academy of Medicine his illuminating paper upon the "Prospects of the Prostatic." In the discussion which followed emphasis was again put upon the practical aspects of the problem. There was apparently an agreement that the operator should employ the method in which he was most proficient. The practical force of this suggestion has a strong appeal, but I feel it has a tendency to react as an obstacle to progress. However, I take it that even the most partisan of suprapubists will hardly fail to be convinced by Dr. Crabtree's reasons for preferring the perineal method. Cases of small fibrous prostates, as he has made plain to us, present difficulties all their own.

In a résumé of recent statistics of perineal versus suprapubic prostatectomies, I find the following:

Young: 1049 Prostatectomies by "conservative perineal" procedure, with 36 deaths in hospital (3.4 per cent). 108 Suprapubic prostatectomies, in 55 of which final results are known 76 per cent were stage procedures—final results good in 60 per cent.

Davis, Edwin: 91 Perineal operations under sacral anesthesia with 1 death (1.1 per cent). Average age of patients, seventy years, with 9 men over 80.

Hinman: Personal cases (number not known). Mortality was between 2 and 3 per cent. In 95 per cent of the surviving cases the cure was complete. There were no persistent rectourethral fistulae and no incontinence of urine as a result of the operation.

Lowsley: Suprapubic cystotomy, 8.4 per cent; perineal, 5.7 per cent. It is only fair to state that these figures include all the staff and residents.

Keyes: 76 Entered hospital, and 11 died there, a total mortality of 14 per cent. Among the 76 patients 10 were not operated upon at all, 3 died promptly without operation, 7 others were temporarily relieved without operation, 4 died after preliminary suprapubic

drainage, and another having been drained refused prostatectomy.

Dr. Bidgood's paper was not only a scientific contribution, but a constructive one. I believe that the gist of his paper was, as he stated (after the work of Dyke of London, England), that the typhoid group and the cocci group of bacteria enter through afferent vessels and have a predilection for the cortex of the kidney, causing carbuncles and perinephritic abscesses. But to me the most important point was the fact that typhoid bacilli and the colon group not only enter by way of the afferent vessels, but pass out through the efferent route into the collecting tubules, causing huge pyonephroses. This type usually results in complete loss of function and nephrectomy. I remember that Dr. Lowsley cystoscoped a patient on whom a diagnosis of perinephritic abscess has been made (in which Dr. Keyes concurred) in spite of the fact that the urine was clear. Bacteriological examination of both specimens showed them to be clear and sterile, but a perinephritic abscess was nevertheless suspected, which was found upon operation to be due to a coccus infection.

DR. JOHN H. MORRISSEY: I would like to know just what Dr. Crabtree means by fibrosis of the prostate. These cases come to us as purely urinary conditions presenting a symptomatology similar to that of the prostatic in general, i.e., dysuria, retention and symptoms of infection. I should like to know on what he makes a diagnosis of fibrosis: digital, cystoscopic or radiographic evidence.

Excluding a ball valve adenoma, which is especially definite, it seems to me that these cases can be classified as anything you want to call them: median bar, contracture of the vesical neck, etc. In the absence of these particular conditions, then, we come to the point where we are dealing with a chronic infection. We are probably all familiar with the recent work of Von Lackum, of the Mayo Clinic, who reported a large number of cases all of which responded adequately to treatment directed towards infection of the prostate, following a punch operation. Bumpus originally reported a punch series showing striking results, with relief of obstruction, etc. Von Lackum later found the results not entirely satisfactory in these cases, but obtained even complete relief by eliminating the infection. Of course in a consideration

of any cases from the Mayo Clinic one must always remember the departmental limitations of that institution. Anyone doing surgery will naturally favor his own particular procedure, and Von Lackum's reports naturally reflect his own department, where he is restricted to massage, the use of dilators and sounds, etc. I believe, however, that in the absence of any pathology in these prostatic cases, as noted previously, they may be considered as merely chronic infection and treatment should be so directed. Not every patient will let you cut into the urethra and attack the prostate through a perineal incision, unless he can be convinced that he has a definite surgical condition. It is therefore necessary for the most part to direct treatment towards elimination of the infection. If this cannot be done, then perhaps a perineal operation is indicated.

Unless one is familiar with the technic of the perineal operation, he cannot appreciate how minor this may be as far as the patient is concerned. The mortality is relatively nil, and the discomfort quite minor.

In any large series of seminal vesiculectomy operations that I have done in the past I felt the results were due not so much to removal of the vesicles as a liberal incision and drainage of the prostate. I have seen prostates fully the size of an English walnut come down to that of a small almond following some 8 or 9 linear incisions. Although Dr. Crabtree has removed the whole gland in these fibrous prostate conditions, as he calls them, I think his results are due principally to relief of the infection. Whether this could have been accomplished just as well by draining the area, removing a small adenoma if present and avoiding the sacrifice of the pieces of gland left, is the question. I do feel and know that complete removal of the gland is a radical procedure; and in many cases of complete removal and suture of the vesical neck to the severed ends of the urethra, urinary control is hard to get. Undoubtedly in all these perineal operations a good part of the control is due to a resulting scar. Possibly in chronic infection we do have a scar which maintains control. Surely if we excise an entire prostate we run a serious risk of getting dribbling and lack of control as a result. I would be very much interested to know what the sections from the glands removed showed: whether chronic infection, whether the remaining glandular tissue was entirely obliterated

by the fibrosis, or whether or not there were any indications of carcinoma cells in the slides.

My point of view towards these kidney cases is not so much a consideration of what the causal factor may be, but what to do with them. In the first case Dr. Bidgood showed here, my view would be that we were dealing with a healed tuberculosis of the kidney with secondary colon infection, and that the kidney should be removed. I must say that my interest would be limited to that consideration alone in such a case.

DR. NATHANIEL P. RATHBUN: We are all familiar, of course, with the theory of the bacterially infected pelvis draining into the urinary tract, and that cocci have a habit of attacking the cortex, cortical infections very many times giving clear urine in the presence of a serious infection of the kidney. However, I did not quite gather from his paper why this occurs.

I think Dr. Crabtree has made an important and original contribution. Dr. Crabtree has had the courage to do a radical operation for a condition which has puzzled all of us. My results in using chiefly the suprapubic approach have never been entirely satisfactory. Several cases where on a second occasion we have opened the bladder widely, with full exposure, and excised portions of a bar with the knife or endotherm, have proved fairly satisfactory, although not to the degree that Dr. Crabtree mentions.

Dr. Crabtree has called his group of cases a small one, but to me it would be large considering the fact that there was no residual. I have had no results approaching his. It occurs to me that it behooves those not familiar with the perineal route to perfect themselves in that technic, and make more frequent use of this operation. The danger, however, lies in the possibility of many cases of incontinence if this original operation of Dr. Crabtree is employed indiscriminately, as it requires a high degree of technical skill.

I confess that I have not had much success with the Young punch or the method advocated by Dr. Collings. I have had some cases where the obstructing bar was removed with the Stern knife. I get better results from the suprapubic approach.

DR. A. R. STEVENS: I think we have all realized for a long time, as has Dr. Bidgood, that the common pyogenic organisms were the ones usually encountered in perinephric

infections, and that it is exceedingly uncommon to meet any member of the colon group. I should want to read his paper over to thoroughly understand his explanation of just why cocci attack the cortex of the kidney and colon bacilli the pelvis. I hope that Dr. Crabtree will discuss Dr. Bidgood's paper, as I think it was prior to the War that he and Dr. Cabot came down here and read a paper on the subject.

At that time Dr. Cabot had a great deal to say about the "long wheel base" of the colon organisms, and in some way amusingly explained it on that basis. I think perhaps that might help to fix the idea in our minds. However, staphylococci are not only found in perinephric infections. It is not a very unusual experience to meet staphylococci with pus in catheterized specimens of urine. To me they have been very difficult cases. I have had three or four very distinct, clean-cut cases of staphylococcus infection (obtained in pure culture) confined to the pelvis and immediately adjacent portions as far as I could make out, on which I tried various dilatations and irrigations without accomplishing anything. One case was freed from the infection by giving intravenous neosalvarsan. In all cases I tried capricol, the drug supposed to be prescribed in such cases; but without benefit.

The very nice way in which Dr. Crabtree has worked out his whole group is to be commended. It seems to me, however, that cases diagnosed as fibrous prostate: i.e., trigonal, vesical neck or median bar conditions, should first of all be treated by some simpler therapy, some form of punch or cautery. Dr. Crabtree thinks he can pick the individuals cases which cannot be helped in that way and will require his more extensive prostatectomy, and I would be glad to know just how that conclusion is arrived at. It seems to me that of the cases which are generally regarded as fit subjects for the various punch operations, three groups have proved unsuccessful: (1), where there is a spinal cord lesion which has not been recognized; (2) the group occasionally met in which there are definite hypertrophied intraurethral lobes (and all cases of this kind should be examined as carefully intraurethrally as intravesically to exclude hypertrophied lobes); and (3), the group which I suppose prompted this more radical operation: that without intraurethral lobe and without spinal cord lesion. In these cases we at Bellevue have employed the punch

operation frequently, with suprapubic control, and have found that after removing four or five obstructing pieces and in some cases going a step beyond and with a scalpel cutting through any remaining scar so that a perfectly pliable posterior aspect to the vesical outlet was left, certain individuals have not become well. A few such cases have been operated upon four times. I had supposed these were individuals who had a very marked predilection for the formation of scar tissue with infection, and of course all these cases have infection after they are opened up. However, they may represent prostates with scar formation extending very deep into the gland. On the basis of either explanation, such individuals would be ideal subjects for Dr. Crabtree's operation.

DR. CLYDE W. COLLINGS: I think Dr. Stevens hit the nail on the head when, in discussing Dr. Crabtree's paper, he mentioned the question of diagnosis. The reason transurethral operations fail is that the patient has intraurethral lateral lobes as well as a fibrous bar, or (as found recently in a Bellevue patient) an enlargement of the subtrigonal type. In this instance we remove two benign lobes underneath the trigone, the size of a small English walnut, after the patient had been punched per urethra or suprapubically four times. Then again, some patients may have a fibrous bar plus a median lobe. We will be asked by the patient or his doctor to do a transurethral operation. These operations usually fail.

It seems to me that if we stick to our knitting and follow only the absolute indications for the transurethral operation, we will be delighted instead of disappointed with the results. I have always stressed the point that this method of cutting through the prostatic urethra with the high frequency current should only be used where there is a definite fibrous bar with a cystoscopic picture of the bas fond, and elevation of the neck of the bladder, as the instrument is withdrawn into the posterior urethra. Sometimes we see a fibrous scar obstructing the neck of the bladder after prostatectomy. This is entirely relieved by the cutting current. And thirdly, patients with obstructing bar due to carcinoma of the prostate, can usually be relieved of their residual urine and put off the time when they will probably come to a suprapubic tube.

DR. MAXIMILLIAN STERN: I agree with Dr. Collings in saying that Dr. Stevens hit the nail



on the head with regard to small fibrotic prostates. However, I cannot agree entirely with Dr. Collings as to resection and diathermy methods.

This gives me an opportunity to tell Dr. Lowsley that his "I told you so" was absolutely correct. At a time when I was very enthusiastic over the resectoscope he said that I would live to say that he was right in contending that it was applicable to only a limited number of cases. The temporary results obtained in frankly infected cases were, I think, entirely due to the fact that we got drainage for a time. All of these prostates undergo the atrophic process of normal senile degeneration until (probably due to the incidence of infection) they get so bad that surgery is the only recourse. However, many people agree with me that operative methods are not the only way of handling a prostate until infection gets out of hand. Up to a certain time it is only proper to try to deal with these prostates as organs normal in all other respects. Very good results are obtained by dilatation, massage, hydrotherapy and diathermy, and in a growing number of cases prostatectomy is averted.

In connection with infective processes and vasligation, I would mention an idea which recently occurred to me. I had an old gentleman as a patient, on whom a vasligation had been done with the idea of causing prostatic atrophy. The prostate and seminal vesicles were infected; the two lateral incisions over the vasa broke down and remained open. These persisted as points of drainage from the vesicles. This case suggested the plausibility of cutting across the vas and letting the distal end drop into the scrotal sac, and of sewing the proximal end to the open wound to permit of drainage. This I have never done but it seems more logical than simple ligation.

In any case, I cannot say that I approve of vasligation in general, and in infected cases I am especially opposed to it.

In frankly fibrotic prostates such as Dr. Crabtree describes I still believe that resection, together with other therapeutic measures, will yield results superior to major surgical procedure.

DR. GEORGE W. STARK (SYRACUSE, N. Y.): I have only two observations to make on these very interesting papers. One is that in Syracuse, as in other smaller cities, we get out cases earlier because of our closer contact with the internist, resulting in a better chance of curing them without surgical interference. The other is

that the Bostonians have been trying for years to put over the theory that certain infections attack certain parts of the urinary tract, because of its embryological development; but I do not think that this theory will work out any better than the rest.

Personally, I do not think all perinephric abscesses arise from the kidney, but that they can come from the outside and approach that organ. Two weeks ago a woman came to me who on examination was found to have a mass in the upper right quadrant. There was nothing pathological in the kidney, the function was normal, and I was so positive that there was no connection with the kidney that I advised an anterior incision. A large inflammatory mass was found attached to the capsule of the kidney. The capsule was free. I believe that had this case been allowed to go on longer, she would have had a perinephric abscess. In such instances, of course, the theory of infection suggested by Dr. Bidgood would not work out.

I have made cultures of several hundred cases of kidney infections, and while the preponderance showed colon bacilli, quite frequently staphylococcus aureus, and once or twice a streptococcus was found.

DR. C. Y. BIDGOOD (*Closing*): I realized before presenting my paper this evening that it was more or less theoretical and had no apparent practical application, as has been pointed out in the discussion.

Assuming that the idea is correct that the colon bacillus tends to attack that part afferent to the glomeruli, Dr. Barringer and Dr. Rathbun have both asked why. I confess that I do not know, unless it can be explained on the basis of bacterial selectivity.

Dr. Morrissey mentioned the possibility of tuberculosis on the basis of the pyelogram shown, as of course anyone would. The case was considered from that viewpoint, too, until numerous microscopic sections from all parts were made and no evidence of tuberculosis was found.

Dr. Stevens' report of a case cured by intravenous neosalvarsan was interesting, because I supposed that when a small abscess due to a coccus infection ruptured into the afferent tubules there would immediately be drainage into the pelvis which would result in a positive culture in the urine. According to Dr. Stevens, he did not get much result from pelvic lavage, probably because lavage would not reach the ultimate source high up in the parenchyma. Cocci often respond to intravenous neosalvar-

san, presumably because it reaches that portion of the kidney afferent to the glomerulus.

Dr. Stark has made some interesting remarks about perinephric abscess. We all know that originally they were classified as primary and secondary, i.e., primary where one could find no abscess in the kidney to account for the perinephric abscess, and secondary where such an abscess was found. That nomenclature has been altered, and those cases in which we find no abscesses in the kidney itself designated as paranephric. Those to which Dr. Stark has called attention are the paranephric type, a slightly different condition from that considered here.

DR. E. G. CRABTREE (*Closing*): The reception accorded the new idea I have presented (or perhaps I had better say "adaptation of an old idea") has been very gratifying.

The question raised by Dr. Barringer regarding my good results as far as residual is concerned leads me to ask him to define normal limits of bladder emptying; that is, how often the normal bladder really empties itself. I have recently considered residual urines in our work on pregnant women at the Boston Lying-In Hospital, only to find wide variation in function in the same patient. If I get complete emptying on most occasions, I take that as a determination of residual. If one took the top figure rather than the lower point in determining residual, quite a marked difference in the degree of function would be shown.

I agree with Dr. Stevens in his statement as to the difficulty experienced in deciding by cystoscopic means alone what kind of prostate we are dealing with. The one-eyed vision offered is not sufficient. I trust that the future will add something more definite to our ability to diagnose these cases. At my clinic we are cystoscoping all of our prostatic cases, and doing cystograms and urethrograms in addition. By comparing these findings and the picture noted at operation with the specimen obtained, we feel that we have learned a little, and may in the future become more expert.

Some confusion seems to exist as to what type of prostate I am operating by the method described. A fibrous prostate is defined as the kind which when felt by rectum is small, not nodular but elastic, and does not raise the question of malignancy. Cystogram shows no deformity of the bladder. Urethrogram shows a short prostatic urethra. In such cases we do total prostatectomy, providing a smooth, regular prostatic urethra through which urine passes

as readily as in the postoperative benign hypertrophy. I do not wish you to infer in any way that the paper presented here tonight is antagonistic to the work of Dr. Collings and others in handling the prostatic bar. These patients belong to a different group. Dr. Collings had made it clear that he *cuts prostatic bars*, but varies from that procedure when there is some other form of obstruction. The group I spoke of is intermediate between Dr. Collings' cases and the ordinary type of prostate in which some surgeons (as Dr. Rathbun has mentioned) do a suprapubic dissection. The method which I have followed for these cases has proved a satisfactory way for me to meet the problem.

Dr. Stevens and others have mentioned prostatic treatment by massage. We are not talking about the same group of cases. I recognize that there is a hard prostate typical of chronic infection and also one which is atrophic and fibrous but obstructive.

Total prostatectomy for carcinoma and that for a fibrous gland are operations of very different magnitude, the former very often technically difficult, the latter much easier. Its virtue in these cases lies in better functional results and more certainty in obtaining satisfactory end results.

Let me say a word in regard to the "long wheel base" of the colon bacillus. I agree with Dr. Bidgood that this is only a theoretical consideration, and I realize that we are on disputed ground. Dr. Cabot and I contended that even though a coccus pyelitis may occasionally be found, the characteristic lesion of the coccus was abscess formation, that of the colon bacillus, tubular inflammation. The work Dr. Cabot and I did some years ago reported data based on pathological examination of tissues taken from the kidney and perinephric region at operations in which an abscess had been found. The group of specimens were examined and sections stained for bacteria instead of relying on cultures where overgrowth of other organisms by the colon bacillus might occur. True perinephric abscess rarely showed any other organism than the coccus. I believe there were but two cases in which bacilli alone were found, and these were not colon bacilli. I still think, after ten years, that if we rely on cultures less and on sections stained for bacteria more, perinephric abscess will be found a coccus disease, and the renal reaction to the "long wheel base" colon bacillus that of a distinctly different disease.

# INTRAVENOUS INJECTION OF GLUCOSE

## ITS EFFECT ON THE RESPIRATORY QUOTIENT\*

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FROM clinical reports the armamentarium of the surgeon has been augmented by a very important factor in the intravenous administration of glucose. During the past five or six years reports from all over the world speak favorably of such intravenous administrations in the treatment of all types of post-operative complications, ranging from slight nausea and vomiting, attributed to anesthesia, to the dehydrating and debilitating effects of such very serious complications as peritonitis and intestinal obstruction. Wherever acidemic states are even remotely suspected its use is advocated very urgently. All types of toxemias have been cited as indications for its employment and almost uniformly the results have been reported to be favorable. In all instances these reports are the results of clinical observations. In no instance that we know of have the results been checked up in a scientific manner, nor is there any explanation based on a scientific foundation of the means by which it accomplishes improvement. A consideration of these facts led us to the problem which is as follows:

1. What happens to glucose after it is injected intravenously?
2. What influence does it have upon the postoperative state?

There are two possible ways in which glucose may be of value to the body. One which immediately suggests itself is its value as a fuel. The other method by which it may be of value is as a foreign body irritant which when introduced into the blood may stimulate the defense mechanism. We shall concern ourselves solely at this time with the consideration of the value of glucose as a fuel in the body.

The history of metabolism is definitely associated with the recognition of the value

of the respiratory quotient as a method for the determination of the relative utilization of the various food stuffs, fats, carbohydrates and protein. Normally in the postabsorptive state after a fourteen to eighteen hour fast the respiratory quotient ordinarily is between 0.78 and 0.82. When proteins alone are burnt the respiratory quotient is about 0.82 and when fats alone are burnt the respiratory quotient is about 0.7. When a glucose plethora is produced in the blood either by the ingestion or intravenous injection of sugar, the respiratory quotient rises toward unity. During the postabsorptive state a rise in the respiratory quotient after the administration of glucose is to be expected normally. Woodyatt<sup>1</sup> has demonstrated that in the normal animal or in man, assimilation of glucose can go on to the extent of 0.8 to 0.9 gm. per kilogram body weight per hour. In order to be certain that we produced a carbohydrate plethora in our experiment, we used these figures and gave 50 gm. of glucose intravenously per 60 kg. of body weight.

### METHOD

This consisted of the determination of the respiratory quotient after a fourteen to eighteen hour fast, the administration of 50 gm. of glucose intravenously (250 c.c. of a 20 per cent solution) followed by another respiratory quotient one half hour later. Blood-sugar determinations before and after the glucose administration were also made. This represents the control experiment. The same procedure was then carried out at the time of operation, the glucose being administered during operation and the respiratory quotient determined immediately after the operation within one half hour after the administra-

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tion of glucose. Spinal anesthesia which does not affect the quotient, was used in all cases. Unselected cases in which various

from which energy metabolism can be calculated and the relative part that each food stuff plays in its production.

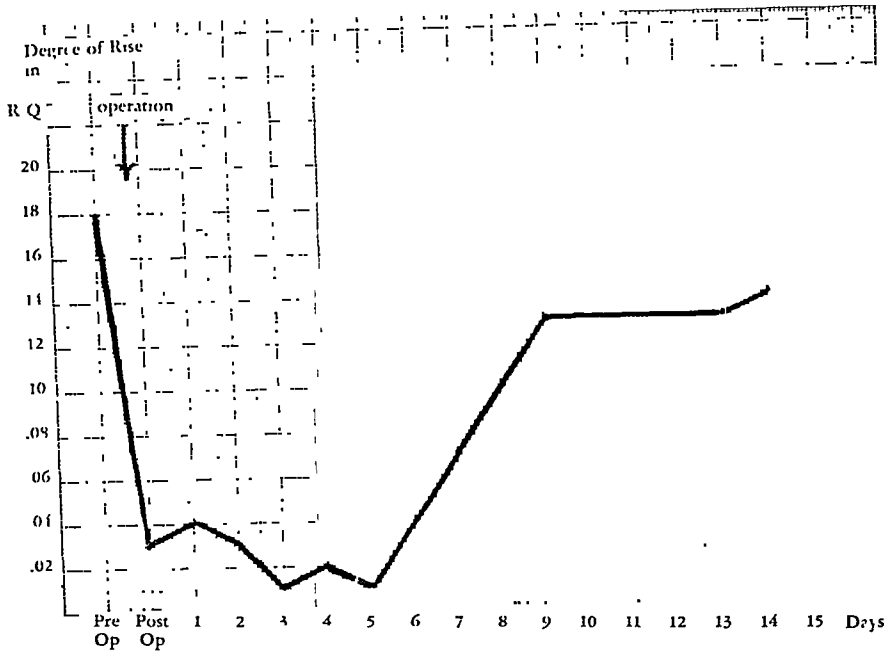


FIG. 1. Degree of rise in respiratory quotient following intravenous glucose administration.

types of abdominal operations including hernias were performed. The procedure used in the control experiment was subsequently repeated at intervals over a period of sixteen days. Cases with postoperative febrile states were not included because it was felt that the respiratory quotient obtained under such conditions might be misleading. In a few instances in which there was postoperative fever the respiratory quotient was also determined and the results will be cited separately.

All determinations were made with the Bailey modification of the Tissot calorimeter and the Henderson modification of the Haldane gas apparatus. Blood sugars were determined by the Folin Wu method. Precautions were taken to obtain the proper mental and physical relaxation before the respiratory quotient estimations were made. All determinations were performed by the same individual.

#### APPARATUS AND METHOD

The Bailey calorimeter is used to determine the respiratory exchange of the body

The subject inspires outside air. One-way valves automatically partition the inspired from the expired air. The expired air is collected in a balanced spirometer for a period of approximately ten minutes. The  $\text{CO}_2$  and  $\text{O}_2$  content of this air is then determined by gas analysis.

The  $\text{O}_2$  and  $\text{CO}_2$  of outside air being known, the difference between these and the  $\text{CO}_2$  and  $\text{O}_2$  of the expired air represent the  $\text{O}_2$  consumed and  $\text{CO}_2$  excreted in the internal respiration of the body. From this data, the energy metabolism of the body is obtained.

A face mask was used in all the determinations. The mask was tested for leaks regularly, and supported by a large rubber dam binder to seal the edges.

The valves for partitioning the air are made of soft gum rubber and completely collapse when the current is reversed.

The spirometer has a capacity of 100 liters. The bell is counterbalanced in any position by a chain and counterweight. Only expired air is collected in the spirometer. The volume of gas collected during

a determination is brought to standard conditions by correcting for temperature and pressure. The air sample for analysis is collected with a Bailey sampling bottle.

The Henderson Haldane gas analyzer was used in our work. The accuracy of the determinations were maintained by checking the analysis of the sample on two different machines. Although at the outset of our experiments we employed the usual alkaline pyrogallate solution for absorbing the  $O_2$ , our subsequent determinations were performed with oxysorbent. We found it much superior to pyrogallate solutions from the standpoint of speed and accuracy in taking up all the  $O_2$  in the sample.

### RESULTS

The results of studies in 14 cases are charted in Table 1. These are typical of the 30 cases studied. Eight preoperative controls are presented which uniformly indicate a decided rise in the respiratory quotient following intravenous glucose administration. In 4 of the cases charted, immediately postoperatively there is a decided diminution in the rise of the quotient following the glucose injection. The 2 cases which show 0.04 and 0.05 rise respectively were complicated in that the quotients were determined at a time when there was no longer any anesthesia, and when the patients were beginning to experience severe pain to which they responded by marked physical and mental activity. From the first to the sixth day there was no rise in the quotient excepting in Case IV, in which there was a rise from 0.69 to 0.76. These figures, however, are still within the range of quotients obtained when fat alone is oxidized. From the seventh day on there is a definite tendency toward elevation of the quotient after glucose administration. The longer the interval of time between the operation and the determination, the closer the approach of the quotient, after glucose administration, to the normal. In starvation, when the liver has been depleted of its glycogen, the administration of glucose

fails to elicit a rise in quotient because of its immediate conversion into glycogen and storage. During acidemic states the true nature of the quotient may be obscured by the pathological elimination of  $CO_2$ . In the cases studied both these sources of error were eliminated. The patients were not starved, and the absence of acidosis was shown by determinations of the  $CO_2$  combining power of the blood.

### DISCUSSION

It can be seen from these studies that there is no rise in the respiratory quotient following intravenously injected glucose for approximately one week after operation. The slight variations observed are within the limits of experimental error. This period coincides with the clinically critical postoperative period. The failure to obtain a rise in the quotient occurs at a time when the physical restlessness and mental anxiety would under ordinary conditions in themselves produce a rise. Thus the inability to produce a rise in the respiratory quotient following glucose administration is particularly significant. Similar results have been observed in experimental animals. Collens and Murlin<sup>2</sup> in unpublished results were unable to produce a rise in the quotient following intravenous glucose in animals with their hepatic arteries ligated. Cori and Cori<sup>3</sup> observed no rise in the quotient following glucose in eviscerated rats.

The glucose injected cannot be accounted for by the respiratory quotient. Apparently then the postoperative state is definitely associated with an inability to utilize glucose. The fate of this glucose is now under investigation and will subsequently be reported.

Two cases reported show the effect of insulin during the postoperative state. In both cases there is a uniform and decided rise in the quotient following its injection. This suggests the possibility that insulin stimulates the oxidation of glucose during the postoperative state.

It is also suggested by these studies that

TABLE I

Case No.	Hosp. Case No.	Date	Operation	Preop. Control	Day of Op. Postop.	Day Postop. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
I	4969	9/28/29	Cholecystectomy	Pregluc. .73 Post .90	...	...	.73 .77	...	...	...	...	...	...	...	.77 .88	...	...	...	...	...	...
II	4984	9/30/29	Appendectomy	Pregluc. .71 Post .97	...	...	...	.75 .75	...	...	...	...	...	.85 1.0	...	...	...	...	...	...	...
III	6084	10/21/29	Cholecystectomy	Pregluc. .70 Post .89	.72	...	...	...	...	...	...	...	.74 .99	...	...	...	...	...	...	...	...
IV	6158	10/28/29	Exploratory Lap. Ca. of Gall Bl. with Metastasis	Pregluc. .72 Post .87	.73	...	.69 .76	...	...	...	...	...	...	.75 .86	...	...	...	...	...	...	...
V	6214	11/ 2/29	Appendectomy	Pregluc. .73 Post .86	...	...	...	.77 .72	...	...	...	...	...	.71 .83	...	...	...	...	...	...	...
VI	6269	11/ 7/29	Separation of Adhesions	Pregluc. .69 Post .87	...	...	...	...	...	.73 .76	...	...	...	...	...	...	...	...	.77 .90	...	...
VII	3892	6/24/29	Left Oophorectomy	Pregluc. .70 Post .80	...	...	...	...	...	...	...	...	.76 .79	...	...	...	...	...	...	...	...
VIII	4189	7/20/29	Thyroidectomy	Pregluc. .77 Post .95	...	...	...	.70 .71	...	...	...	...	...	...	...	...	...	...	...	...	...
IX	4075	7/10/29	Cholecystectomy	Pregluc. .73 Post .86	...	...	.74 .75	...	...	...	...	...	...	...	...	...	...	.75 .86	...	...	.75 .76
X	3844	6/20/29	Exc. Gall Bl. App. Ventral Fixation	Pregluc. .73 Post .78	.73	...	...	...	...	.70 .71	...	...	...	...	...	...	...	...	...	...	...
XI	4354	8/ 6/29	Perineorrh. Hemorrh.	Pregluc. .73 Post .74	.73 .74	...	...	...	...	...	...	.74 .76	...	...	.72 .78 .82*	...	...	...	...	...	...
XII	6167	10/28/29	Suprapubic Cystotomy	Pregluc. .73 Post .86	.73	...	...	...	.70 .72	...	...	...	...	...	...	...	...	...	...	...	...
XIII	4317	8/ 2/29	Prostatectomy	Pregluc. .70 Post .81*	.70 .81*	...	...	...	...	...	...	...	...	...	...	...	...	.72 .75 .82*	...	...	.73 .97
XIV	4069	7/ 9/29	Cholecystectomy	Pregluc. .74 Post .73	...	...	...	.74 .73	...	...	...	...	...	...	...	...	...	...	...	...	...
			Appendectomy Perineorrhaphy	Pregluc. .73 Post .84	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

\* Respiratory quotient following intravenous administration of 17 units of insulin.

the inability to utilize sugar runs parallel to the severity and the duration of postoperative shock. The patient in CASE VII who was subjected to a very extensive operative procedure and who had a left internal saphenous vein phlebitis from the eleventh postoperative day on, is illustrative. The patient in CASE XIII who was operated on for a gangrenous cholecystitis had a prolonged and troublesome convalescence. These two were the only cases in the series who ran stormy postoperative courses and at the same time were the only patients who sixteen and thirteen days respectively after operation showed no rise in the quotient following glucose injection.

It appears from these results that the administration of glucose early in the postoperative state is of questionable value as a fuel. Following operations a large percentage of patients suffer to a greater or less degree from vomiting. These patients who cannot retain, digest and absorb foods, burn their own reserve of carbohydrates and fat and have a tendency to develop an acidemia which in turn

favors further vomiting. Intravenous glucose has been strongly advocated as the panacea in these cases; but according to our results, there is no evidence to indicate that the exogenous glucose at this stage can spare fat and protein breakdown.

#### CONCLUSIONS

1. The respiratory quotient does not rise following intravenous glucose administration after abdominal operations for a period of approximately one week.
2. Insulin may be able to stimulate the oxidation of sugar during this period.
3. The postoperative state is definitely associated with a disturbance in carbohydrate metabolism.

NOTE: We desire to express our thanks to the members of the Staff of the Crown Heights Hospital whose cooperation made it possible to secure the clinical material for study.

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# MANAGEMENT OF THE THYROID HEART\*

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THE "thyroid heart" as commonly known is that heart condition or abnormality which is found in patients who present themselves for the treatment of a thyroid dysfunction.

This paper is prompted because of controversies between surgeons in respect to the use of digitalis in the preparation of thyroid cases for surgery. Should digitalis be used in all cases? If not, in what type of case is digitalis indicated? Or should digitalis not be used? In this discussion the merits of the different types of treatment (medical, surgical or radiological) for goiter will not be considered.

Every surgeon handling goiter cases should associate himself with an internist or cardiologist and should have a careful study of the cardiac condition made before surgery is attempted. In no other condition will a close cooperation between the internist and the surgeon so strikingly improve the service to the patient as in the surgical treatment of a thyroid dysfunction.

The thyroid heart is a disordered action of the heart as seen in cases of thyroid disease. It is most frequent in cases of exophthalmic goiter (Graves' disease) and the so-called toxic adenoma. Although we may find occurring simultaneously with goiters any or all of the conditions which may occur in heart disease, still there is nothing that can be found macroscopically or microscopically that is pathognomonic of thyroid disorder. It is a functional disturbance, and should be considered as a disordered action of the heart dependent and secondary to a disease of the thyroid gland which *cannot be cured* unless the causative agent is eliminated, namely the *thyroid disorder*.

## PATHOGENESIS OF THE THYROID HEART

The disordered action of the heart is dependent upon a disordered function

of the thyroid gland, except in those cases in which an enlargement of the gland or its position mechanically, through pressure, etc., alters the functions of neighboring structures and is the cause of cardiac disturbances (goiter heart of Rose).

There is an increase in size of the thyroid gland with an increased vascularity and a corresponding hypersecretion of the gland. Plummer believes that so-called toxic adenomata produce a pure hyperthyroidism and that the excessive secretion differs in no way from the normal secretion; but in exophthalmic types the secretion is not only excessive, but is qualitatively changed from the normal. According to Kendall this change is brought about by an alteration of the imino group (CO-NH) and not a change in the iodine content. Regardless of what the chemical change is or the type of goiter with which we are dealing, there is a profound effect upon the nervous system. These patients as a rule are nervous and emotional. They speak and move quickly. Tremors of the hands and tongue are common and we have a symptom complex that is identical with an overstimulation of the sympathetic nervous system (sympatheticotonia).

The activities of the internal organs are by no means so dependent upon nervous control as are the activities of the voluntary muscles. If the nerve supply to the latter is interrupted their activities cease. If it is interrupted in the former, no serious results necessarily follow. Nervous impulses modify and direct the activities of the internal organs but are not essential to a continuation of these activities. The central vegetative nervous system has a depressor action whereas the sympathetic system has an accelerator action. There is a definite something secreted or controlled by the thyroid gland which controls the balance between these two

\*Read before the Pacific Coast Surgical Association, February 22, 1929.



systems. This is easily seen when a direct comparison is made between the clinical manifestations in a case of hyperfunctioning thyroid gland and a case in which there has been a total removal of the gland (Table 1).

TABLE 1

Total Removal of Thyroid (Cachexia Thyreopriva)	Hyperfunction of Thyroid (Graves' Disease)
1. Absence of gland	Swelling of the thyroid gland; hypervascularization of gland.
2. Cold skin, without flushings.	Vasomotor instability.
3. Slow small, regular pulse.	Frequent, tense and at times irregular pulse.
4. Uninterested quiet stare without expression of life.	Anxious, changing glances.
5. Narrow palpebral aperture.	Wide palpebral aperture (exophthalmos).
6. Slow digestion and excretion, poor appetite, requiring little food.	Abundant secretions, excessive appetite with increased need of food.
7. Retarded metabolism.	Increased metabolism.
8. Skin thick, opaque, dry and scaling.	Skin thin, transparent and moist.
9. Short, thick fingers with broad ends.	Long slender fingers with pointed ends.
10. Sleepy.	Wakeful and disturbed sleep.
11. Slow sensation, apperception and action.	Increased sensation, apperception and action.
12. Lack of thoughts, interest and emotion.	Flight of ideas, psychic excitation.
13. Slow, awkward muscular movements.	Constant activity and haste.
14. Stiffness of the extremities.	Tremor and increased mobility of joints.
15. Constant chilliness.	Unbearable feeling of heat.
16. Slow difficult breathing.	Superficial breathing with imperfect inspiratory expansion.
17. Increase of weight.	Loss of weight.

#### INFLUENCE OF GOITER ON THE HEART

Because of the accelerator effect of the sympathetic nervous system in goiter there is a speeding-up of the cardiac rate (heart hurry) or tachycardia. Tachycardia may be either simple or paroxysmal in type and is often spoken of as palpitation. The minute cardiac output of blood from the heart is increased in direct proportion to the rapidity of the heart beat and it naturally follows that the centripetal circulation, or the rate of flow through the capillaries, is likewise speeded up,

resulting in an increased oxidation of the tissues. The general level of blood pressure may be normal, elevated or reduced; but the pulse pressure is almost regularly increased. These changes in pulse rate and pulse pressure roughly parallel the changes in metabolic rate and they doubtlessly depend in part upon the general level of body metabolism. The accidental murmurs heard over the heart, the palpitation and excessive arterial pulsations are all due in part to excessive cardiac activity.

#### THE SYMPATHETIC NEUROSIS ACCOMPANYING THYROID DISEASE

Palpitation, tachycardia, dyspnea and general muscular weakness are all common and constant symptoms of thyroid disease. These symptoms should not be interpreted as heart signs. Palpitation is a symptom of disturbed sensation. It is a mark of the heightened nervous irritability so characteristic of thyrotoxicosis. Tachycardia or increased rate is merely a physiological adaptation and, like dyspnea, a physiologic response, and partly due to the general muscular weakness and inefficiency of the thyrotoxic organism in doing work.

#### DECOMPENSATION

Because of the excessive cardiac activity a thyroid heart will eventually become decompensated. The length of time that the heart must carry this added load is in direct proportion to the degree of decompensation. Long-standing cases frequently show evidence of myocardial disease, such as cardiac dilatation and hypertrophy with incidental extrasystoles or auricular fibrillation. Myocardial failure is more frequently noted in the chronic nodular goiter that brings the patients to the doctor after the age of forty than in the acute exophthalmic type.

A decompensated thyroid heart presents the same problem as any other decompensated heart. The signs of decompensation are the same rapid irregular rhythm (fibrillation), enlargement of the liver,

edema of the extremities and general anasarca (ascites and pleural effusions).

Auricular fibrillation is not alone a sign of cardiac decompensation. A heart may fibrillate and still be compensated. This peculiar irregularity is, in most instances, constant, so much so that it has been called the permanent irregularity (*P. irregularis perpetuus*). As a rule patients who have an auricular fibrillation from mitral stenosis or some other organic heart lesion are oblivious to the irregularity of the fibrillation, but the thyrotoxic patients, because of the heightened nervous irritability, are particularly distressed by the irregular beats and complain quite bitterly of them.

Auricular fibrillation in patients with thyroid disease is more amenable to treatment because it is not usually associated with any organic heart lesion, and when present without any accompanying cardiac decompensation often disappears completely with the elimination of the offending cause, thyroid disease.

#### PREOPERATIVE TREATMENT

Having decided that the case of a patient with thyroid disease is a surgical one, our problem is to give such treatment as will take the patient through the surgical experience with the least risk. Our preoperative treatment is divided into two classifications:

1. Those cases with compensated heart.
2. Those cases with decompensated heart.

There is no difference in these two types of cases with the exception that digitalis is indicated in those cases with decompensated heart and not in the others. Both types of patients are placed in the hospital and given absolute rest in bed. The patient is not allowed up for any reason. Visitors are excluded and quiet is maintained as much as possible. The patient must be kept happy. The diet consists of nutritious meat-free foods, without tea or coffee, averaging 1500 calories per

day. Sedatives that do not contain alcohol are given as necessary for alleviation of excessive nervousness.

Both types of cases receive Lugol's solution of an average dosage of 15 to 20 minims three times a day in water after meals.

This treatment as outlined is used for both classes of patients for a period of one week to ten days prior to surgery. However, those cases with signs of cardiac decompensation are rapidly digitalized.

TABLE II  
PREOPERATIVE TREATMENT

Compensation	Decompensation
Rest in bed	Rest in bed
Sedatives	Sedatives
Lugol's solution	Lugol's solution
No digitalis	Complete digitalization
Quinidine Sulphate for Fibrillation.	

#### DIGITALIS

It makes little difference in what form digitalis is administered; providing the preparation is potent and in a sufficient amount, digitalis effects may be confidently expected. It should be remembered that the tincture rapidly loses potency. The glucosides are soon reduced to inert sugars by exposure to light and air, so that the tincture should be freshly prepared if its potency is to be depended upon. The part of wisdom is to use few preparations and to obtain them from the same source. The powdered dried leaves are perhaps the preparation of choice.

Only rarely is there a true need of introducing digitalis otherwise than by mouth as it has been shown that where given in sufficient dosage a therapeutic effect may be observed in five or six hours and the maximum in twelve or eighteen hours.

Pardee found that the average individual disposes of about 22 minims of the tincture per day or the equivalent to 2.2 grains of the powdered leaf. Keeping this in mind the danger of the cumulative action of digitalis has certainly been overemphasized. Cushny has aptly compared the administration of digitalis in massive dosage to a

simple chemical titration in the laboratory. Where the strength of the reagent is known, it is safe to run in from the burette a relatively large quantity of salt, and then complete the reaction with a few drops as the end point is reached. If we obtain the desired result the dosage is adequate and further use of the drug is contraindicated.

Digitalis will not control a tachycardia and has been frequently maligned because it failed to do so. Lugol's solution is by far the better therapy. If however, the patient has evidence of cardiac failure, digitalis should be employed in exactly the same fashion as a preoperative measure as it would be in the treatment of cardiac failure without an operation looming upon the horizon.

There appears to be no justification for the routine employment of digitalis in patients with normal hearts before operation.

The Eggleston method of dosage and administration of digitalis has become standard and we can do no better than adhere closely to the rules as originally laid down by him. A rough easy modification of Eggleston's method is 0.2 grain or 0.01 gram of the powdered leaf per pound of body weight of the patient, and for the tincture ten times the same dose in cubic centimeters. This gives the theoretical total amount which a heart requires for complete digitalization within safe limits.

#### METHOD OF ADMINISTRATION OF CALCULATED AMOUNTS

1. When a patient has received no digitalis within ten days:

Six hours apart	{	1st dose: $\frac{1}{3}$ — $\frac{1}{2}$ of total amount
		2nd dose: $\frac{1}{5}$ — $\frac{1}{4}$ of total amount
		3rd dose: $\frac{1}{8}$ — $\frac{1}{6}$ of total amount

Then  $\frac{1}{10}$  total amount three times daily until digitalization is complete.

2. If patient has been receiving digitalis in preceding ten days the total calculated dosage should be reduced, the amount of

digitalis retained allowing an average of 2.2 grains excreted per day. If this cannot be done then the total dosage is reduced to 75 per cent and the procedure already given is followed.

#### TIME TO OPERATE

When all signs of decompensation have disappeared, usually seven to ten days after complete digitalization, surgical treatment should be instituted. To wait at this time will again subject the heart to those influences that caused the original decompensation i.e. thyroid dysfunction.

Quinidine sulphate is often invaluable in controlling the fibrillation in these cases where no decompensation is present or after the heart has become compensated.

#### SUMMARY

1. Surgeons should be associated with a cardiologist in the preoperative treatment of thyroid heart conditions.

2. The "thyroid heart" is a functional disturbance and cannot be cured unless the causative agent, thyroid disease, is eliminated.

3. Thyroid hearts eventually become decompensated.

4. Palpitation, tachycardia, dyspnea and general muscular weakness are not heart signs but are only evidences of the sympathetic neurosis accompanying thyroid disease.

5. A decompensated thyroid heart presents the same problem as any other decompensated heart.

6. Digitalis is of value only in the presence of a decompensation and is not used otherwise.

7. Digitalization should be quick and complete.

8. Digitalis is invaluable in lessening the cardiac output prior to operation and may be the deciding factor in the patient's recovery.

9. Operation must not be delayed after compensation has been restored.



# SPLENECTOMY FOR THROMBOCYTOPENIC PURPURA HEMORRHAGICA

WITH CASE REPORTS\*

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**T**HROMBOCYTOPENIC purpura hemorrhagica is characterized by:

1. A marked decrease in the blood platelets.

2. Normal coagulation time.
3. Prolonged bleeding time.
4. Absence of retraction of the blood clot.

5. Changes in the capillaries, and possibly the whole reticuloendothelial system.

The red and white cells are normal in character.

This disease is not hereditary, but it occurs most often in youth, from three and one-half years up. The bleeding may occur anywhere in the body, beneath the skin or mucous membranes, or from the vagina, rectum, or other orifices. The tendency to bleed is often well shown in these patients by the tourniquet test. Sufficient pressure in the blood pressure cuff to obliterate the venous flow but not the arterial, causes petechial hemorrhages.

The blood platelets originate from the megacaryocytes of the bone marrow and furnish a substance called thromboplastin which hastens coagulation.

There are various theories as to the cause of the disease:

1. That it is primary in the bone marrow and due to defective formation of platelets. If this is correct, why is there such a large and sudden increase in the platelets after splenectomy?

2. That the normal platelets are destroyed by a toxin in the blood.

3. That normal platelets are destroyed in the spleen.

The consensus of opinion of those who have studied the disease seems to be that the platelets are probably formed in normal numbers but are destroyed by the

spleen and the reticuloendothelial system. The capillaries also are altered so as to become more permeable, probably by a toxin.

Splenectomy has effected a cure in a considerable percentage of cases. It was first performed in 1916 by Kaznelson.

Whipple collected 81 cases. Of these, 73 were chronic. There were 6 deaths. Eight were acute with 1 death. Later reports from 61 showed that there were 51 good results, 4 fair results, and only 6 poor results; i.e. about 90 per cent were successful.

The fact remains that a few cases are not cured and splenectomy causes practically no rise in the platelets in some cases.

Morrison, Lederer and Fradkin report a case where an accessory spleen was seen but not removed at operation and a cure was not obtained. This may explain other failures.

Accessory spleens are commonly seen in the autopsy room and should be searched for at operation upon these cases of thrombocytopenic purpura. In the case about to be reported such an accessory spleen was found and removed.

The cases where an enlarged spleen is removed seem to do better than others.

Kaznelson early noted that, of 4 cases observed, 3 had an enlarged spleen.

In considering the advisability of splenectomy and the operative risk to be incurred, one must not forget that the disease itself at times proves fatal.

Hamilton and Waugh report a case that died with symptoms of intracranial hemorrhage within three months of the first hospital admission. The previous duration of the disease was not stated. Another fatal case is appended.

\* Read before the Brooklyn Surgical Society, January 2, 1930.

Splenectomy, in normal individuals free from purpura, is followed usually by a marked increase in the platelets.

Most writers agree on the danger of splenectomy in the acute form and the unsatisfactory after-results in many cases, although Killins has reported an acute case with operation upon the sixth day and complete recovery.

The following case is one of thrombocytopenic purpura cured by splenectomy:

CASE I. K. S. Hospital No. 128190. First surgical service, Methodist Episcopal Hospital.

Age, sixteen Female. Born in U. S. Student Family physician, Dr. H. L. Hall.

Admitted to hospital August 4, 1928. Discharged August 23, 1928.

should have ceased, it continued unabated and contained large dark clots. The patient became increasingly weak and had four fainting spells, the last of which was upon the morning of admission.

The patient has always developed black and blue marks from even slight trauma from childhood up, and her hands and arms show such spots at the present time. Ergot has been taken by mouth for a few days and seemed to lessen the flow about one quarter.

*Physical Examination:* This shows a rather stout girl in an extremely weak condition and with great pallor of her lips and mucous membranes. Blood is coming from the vagina, and there are hemorrhagic spots on her hands and arms.

For vaginal examination, see record of curettage.

Date	8/4/28	8/9/28	8/10/28*	8/14/28	8/22/28	4/16/29
Red cells	2,400,000		3,200,000	4,040,000	4,544,000	2,050,000
Hemoglobin (per cent)	25		36	53	70	18
White cells	6,400		11,000	8,450	6,200	8,400
Platelets		30,000	40,000		80,000	136,000
Polynuclear neutrophiles (per cent)	68		65	70	73	75
Polynuclear eosinophiles (per cent)			2	10		
Myelocytes (per cent)			10	10		
Small mononuclears (per cent)	32		26	28	25	23
Large mononuclears (per cent)			60		20	20
Normoblasts			2 per 100 WBC		Occa- sional	Few
Coagulation time (min.)	3½		..			3½
Bleeding time (min)			Over 16			Over 17
Tourniquet test			Slightly positive			

*Past History:* She has generally had good health but has had measles and pertussis and had trachoma eleven years ago. Her thyroid gland was somewhat enlarged at fifteen years. Her menstrual periods started at twelve years, have come every twenty-eight days, and lasted four days. The flow has been moderate. There have been no clots and no pain in the past.

*Family History:* Father and mother are living and well. There was no history of bleeding in other members of the family.

*Present Illness:* This started twelve days ago with bleeding from the uterus. This blood was bright red in color and about normal in amount for the regular period which was then due. After four or five days, when the flow

An admission blood count showed 2,400,000 red cells, 25 per cent hemoglobin, 6,400 leucocytes, 88 per cent polynuclears, and 32 per cent lymphocytes. The coagulation time was three and one-half minutes. The patient was Type III for transfusion.

A transfusion of 1,000 c.c. was given on the day of admission by the direct Unger method, by Dr. H. W. Mayes. Following this, the blood count rose to 3,136,000 red cells and 48 per cent hemoglobin. The bleeding from the uterus continued, however, and two days later, August 6, 1928, Dr. Mayes performed a dilatation and curettage. The uterus was found enlarged to the size of a two-months' pregnancy, but the curettage failed to yield any gross material, and microscopical examination showed

nothing but blood clot. The uterus was packed.

For two days following this operation, there was practically no bleeding, but, as soon as the packing was removed, the flow commenced again.

A blood count on August 9, 1928, did not show a great drop, but the platelet count at this time showed only 30,000 platelets. This was repeated the following day and gave 40,000 platelets. A smear at this time showed slight pallor of the erythrocytes and moderate anisocytosis and slight poikilocytosis with an occasional rare normoblast, i.e., 2 normoblasts to every 100 W.B.C. counted.

The blood pressure was 112/70. The bleeding time was over sixteen minutes. The tourniquet test was slightly positive.

A consultation was held with Dr. N. Rosenthal, hematologist of Mt. Sinai Hospital. He confirmed the diagnosis of chronic purpura hemorrhagica and stated that the blood picture was typical of thrombocytopenic purpura hemorrhagica. He advised splenectomy if transfusions failed to arrest the menorrhagia.

On August 11, 1928, another transfusion of 600 c.c. was given. Following this the bleeding gradually ceased, and the patient returned home.

On April 13, 1929, the patient again returned to the hospital. Four months previous to admission, she had a profuse period of longer duration than usual. The two succeeding periods were also increasingly long and profuse, and she had been suffering from uterine bleeding for a month preceding her admission. Her pulse was 120 and blood pressure 105/50.

A transfusion of 540 c.c. was given on April 14, 1929, and following this, the right arm bled for three hours. The bleeding was finally stopped by thromboplastin. The blood count was 2,050,000 red cells, 20 per cent hemoglobin, 8,400 leucocytes, and 79 per cent polynuclears with 21 per cent mononuclears; later there was an occasional nucleated red cell.

The platelet count on April 16, 1929 was 136,000. A second transfusion on April 17, of 760 c.c. brought the blood count up to 3,040,000 red cells and 27 per cent hemoglobin. The platelets dropped to 119,000. Even after these two transfusions, the bleeding time was over seventeen minutes, although the coagulation time was only three and one half minutes.

Dr. Rosenthal, at another consultation, advised a splenectomy.

On April 22, 1929 a transfusion of 900 c.c. was given by Dr. Seymour Clark who left the vein exposed at the close of the transfusion.

A splenectomy was then performed (Henry F. Graham) through an upper left rectus, hockey-stick incision. The spleen measured  $15 \times 11 \times 4\frac{1}{2}$  cm. It was soft and composed of glandular tissue throughout. Microscopical sections showed a marked proliferation of the reticuloendothelial cells. There were large areas where these cells had completely replaced the lymphoid tissue. There was a short main pedicle and a larger accessory pedicle deeply placed at the upper pole. A small accessory spleen was found in the neighborhood. This was also removed.

At the close of this operation, Dr. Clark introduced 700 c.c. of blood from another donor directly into the same vein. The patient

Date	4/19/29	4/23/29	4/26/29	4/29/29	5/17/29	8/5/29
Red cells	3,040,000	3,270,000			4,330,000	4,208,000
Hemoglobin (per cent)	27	28			47	75
White cells	7,450				5,900	11,900
Platelets	119,000	136,000	310,000	298,000	332,000	
Polynuclear neutrophiles (per cent)	69			54	54	78
Polynuclear eosinophiles (per cent)						
Myelocytes (per cent)	1					
Small mononuclears (per cent)						Trans- sitional 2
Large mononuclears (per cent)	30			46	46	11
Normoblasts						9
Coagulation time (min.)						
Bleeding time (min.)			$3\frac{1}{2}$			2
Tourniquet test			$2\frac{1}{2}$			$1\frac{1}{2}$

\* Dr. Rosenthal.

left the table in good condition. The following day the red cells were 3,270,000, hemoglobin 28 per cent platelets 136,000.

The highest postoperative temperature was 102°F. A gastric lavage was done on the day following operation because of vomiting, but only clear fluid was obtained.

The bleeding from the vagina continued following operation, but on the third day became less, and on the fourth day there was no vaginal bleeding. It had ceased and did not recur while the patient was in the hospital. There was primary union in the operative wound.

On April 26, the platelet count was 310,000, coagulation time three and one half minutes, bleeding time two and one half minutes. On April 29, it was 298,000, and the red cells were 3,450,000 with a hemoglobin of 35 per cent. May 4, the platelets were 306,000, red cells 3,580,000, hemoglobin 38 per cent. May 17, platelets were 332,000, hemoglobin 47 per cent.

Patient discharged as recovered on May 19, 1929.

On August 5, her weight was 209, red cells 4,208,000, hemoglobin 75 per cent, leucocytes 11,900, polynuclears 78 per cent, small lymphocytes 11 per cent, large lymphocytes 9 per cent, transitionals 2 per cent, coagulation time two minutes, bleeding time one and one half minutes, platelets 536,000.

This patient has been seen several times since her discharge from the hospital. The last time was Sept. 4, 1929. She has remained well. Her periods are now normal.

A second case of thrombocytopenic purpura was found in our hospital files.

CASE II. No. 116999. Female, eighteen years. Admitted, February 10, 1927. She was bleeding from the gums, lips, nose and vagina, and this had persisted off and on for eight months since the birth of a child. The vaginal bleeding had lasted a month, and there were petechiae under the skin and an enlarged spleen. The hemoglobin was 17 per cent, and the red cells were 1,450,000. The coagulation time was four and one half minutes. The platelets, on two counts, were 60,000 and 28,000. The bleeding time was not taken. She bled from the rectum and stomach and died February 24, 1927 in spite of a transfusion.

Differential diagnosis should exclude hemorrhagic purpura not of the thrombocytopenic type.

An interesting case illustrating this was seen at the Norwegian Hospital:

CASE III. M. S. No. 25109. Thirty-five years. Admitted May 6, 1927.

An operation was performed consisting of an appendectomy, cholecystectomy, trachelorrhaphy, and perineorrhaphy. On May 19, nine days later, she began to bleed from the perineum, and this was resutured without result. Further history revealed that her father was a bleeder and that she once bled profusely after labor.

The blood came steadily in a slow stream from her vagina until she became pulseless and unconscious. A telephone consultation with Doctor Ottenberg gave us a tentative diagnosis of purpura hemorrhagica and the advice that massive transfusion was indicated. Two donors were used in succession and 1480 c.c. of blood given, with recovery. Two later transfusions, amounting to 1730 c.c., brought the total used in four days to 3210 c.c. The platelet count was 1:8 on May 23 and 1:10 on May 26, totaling 266,000. The lowest red cell count was 2,710,000 with 40 per cent hemoglobin, polynuclears 84 per cent, lymphocytes 16 per cent, white cell total 11,600.

An interesting case illustrating one of the problems in differential diagnosis is the following one of aleucemic leucemia.

CASE IV. No. 121922 December 4, 1927.

The patient was a female aged forty-nine, showing multiple ecchymoses of the skin and mucous membranes. The red cell count was 3,800,000, hemoglobin 70 per cent. The platelets varied between 30,000 to 105,000 on the day following transfusion. The white cells were 4,000, the polynuclears 22 per cent, the lymphocytes 78 per cent, coagulation time six and one half minutes, bleeding time five minutes.

Discharged December 18, 1927 as improved.

The diagnosis was made by Dr. N. Rosenthal. A low total white count and a high differential lymphocyte count, with many immature forms, characterizes this condition.

Hemophilia gives a family history, being transmitted through the female with active bleeding in the male. The coagulation time is much prolonged. The bleeding time is often diminished. The platelet count is normal.

[NOTE: For bibliography see author's reprints.]

# AMEBIC ABSCESS OF THE LIVER\*

## METHOD OF TREATMENT

### INJECTION OF CAVITY WITH IODIZED OIL FOR DEFINITE LOCALIZATION

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**A**BSCESS of the liver is one of the most serious complications or sequelae of *endameba histolitica* infection of the intestinal tract. Although involvement is seen much more frequently in tropical countries, the condition is by no means uncommon in temperate countries.

The chances of recovery in amebic abscess of the liver depend to some extent upon the stage of the disease when first diagnosed, the site and size of the abscess, and whether multiple or single. Of more importance, however, is the method of treatment to be followed, as demonstrated in recent statistics which show that the mortality has dropped from a tremendous height to below 5 per cent.

It is interesting to note that only a few years ago one of America's foremost surgeons of today wrote in a *Practice of Surgery* the following: "Aspiration as a curative measure combined with siphon drainage has been recommended by some. It is unsurgical, and even as a diagnostic procedure should not be resorted to until one is quite ready to proceed with the operation. Puncture of the liver for the purpose of locating pus should not be made until after the abdomen or the thorax has been opened, and as regards multiple abscesses little can be hoped for from surgical treatment."

What then is the reason for the drop in the mortality rate aside from the use of emetine? It is the general adoption of that "unsurgical" instrument, the aspirating needle, for diagnosis and treatment.

Sir Leonard Rogers states, "there is probably no serious tropical disease in which so much advance has been made during the last quarter of a century both in prevention and cure as in amebic

hepatitis and its sequel, if not urgently and efficiently treated, liver abscess. The aspiration and emetine treatment is now in general use and the open operation is to all intents and purposes obsolete except under unusual conditions."

Notwithstanding the convincing small fatality rate of those using the aspiration and emetine method, it may still be stated that there are 3 recognized methods of treatment in amebic infection of the liver: (1) medicinal, with intramuscular injections of emetine hydrochloride, to be followed by oral administration of ipecacuanha; (2) aspiration of the abscess one or more times, plus emetine hydrochloride intramuscularly and ipecacuanha orally; (3) incision and drainage of the abscess plus emetine hydrochloride and ipecacuanha.

There are those who believe that aspiration or incision and drainage are quite unnecessary in the majority of patients with hepatic involvement and that emetine injections and ipecac orally are not only sufficient in the presuppurative stage, but also in definitely developed abscess. While no doubt exists as to the efficiency of emetine alone in hepatic involvement, yet it is evident that convalescence is hastened and serious sequelae may be prevented by the addition of operative measures. When once an abscess has developed, convalescence will be greatly hastened by relieving the patient of the more or less toxic abscess fluid, which would otherwise be slowly absorbed or encysted.

While no doubt exists that large abscesses do disappear quite rapidly following emetine injections in patients who have refused operation, yet such routine methods of treatment should not be considered proper. It would seem better to reserve

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the medical treatment, so-called, for the patient who comes for treatment while the hepatic involvement is still in the

The accompanying radiographs illustrate a liver abscess localized by injection of iodized oil. Following aspiration of four

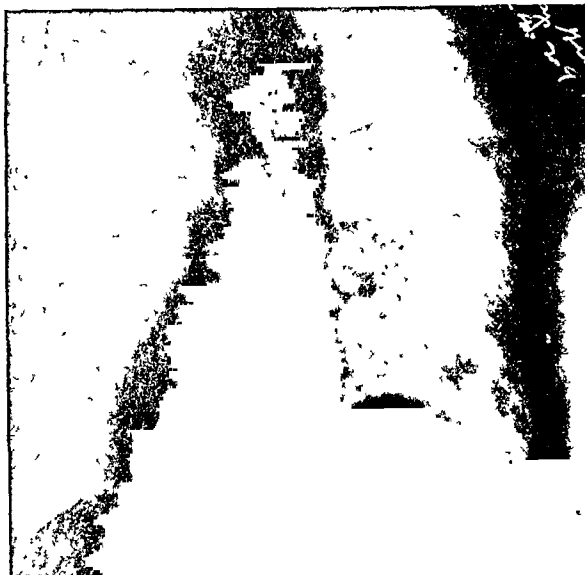


FIG. 1. Amebic abscess of liver previous to aspiration. Definite pointing of abscess.



FIG. 2. Amebic abscess of liver after aspirating  $4\frac{1}{2}$  oz. of pus and injecting 1 oz. of lipiodol. Anteroposterior and lateral views localize position of abscess quite satisfactorily for further aspiration or for incision and drainage.

presuppurative stage or for the patient with multiple small abscesses where open operation and drainage are hopeless as regards satisfactory drainage. The early recognition of a presuppurative amebic hepatitis is imperative if later suppuration is to be avoided by the use of emetine and epecacuanha.

The success of operative treatment of amebic abscess of the liver depends upon the ability to bind the abscess or abscesses and to remove the contents either by aspiration or by incision and drainage.

Even after aspiration has been successfully done once, there may be considerable difficulty in finding again the abscess cavity for subsequent aspiration although one may have a general idea of the depth and the relative direction in which the needle first found amebic pus. The use of some opaque substance for injection into the cavity following aspiration of the amebic pus before altering the position of the needle, and subsequent radiographic examination of the liver region in two planes, establishes quite satisfactorily the position of the abscess for future operative procedures.

and a half ounces of chocolate amebic pus, one ounce of iodized oil was injected into the partially collapsed abscess cavity through the aspirating needle. Radiographs were then immediately made in the anterior-posterior and the lateral views. Radiographs repeated two days later showed almost complete disappearance of the iodized oil, apparently due to absorption.

Aspiration, singly or repeated, plus the intramuscular injections of emetine, offers the most satisfactory results and is a life-saving procedure. Under such treatment the mortality has been reduced from far above fifty per cent to less than five per cent. Chatterji has even reduced his fatality statistics in 186 cases to less than two per cent, by the general adoption of the aspiration and emetine method of treatment.

The average patient with amebic abscess of the liver is in an exhausted condition and cannot bear well the shock of an open operation. Aspiration on the other hand usually can be done under a local anesthetic.

sia and is relatively free from shock. The absence of shock following aspiration accounts for a large percentage of the

of benefit while incisions with drainage will certainly result in secondary infection and prolonged suppuration.

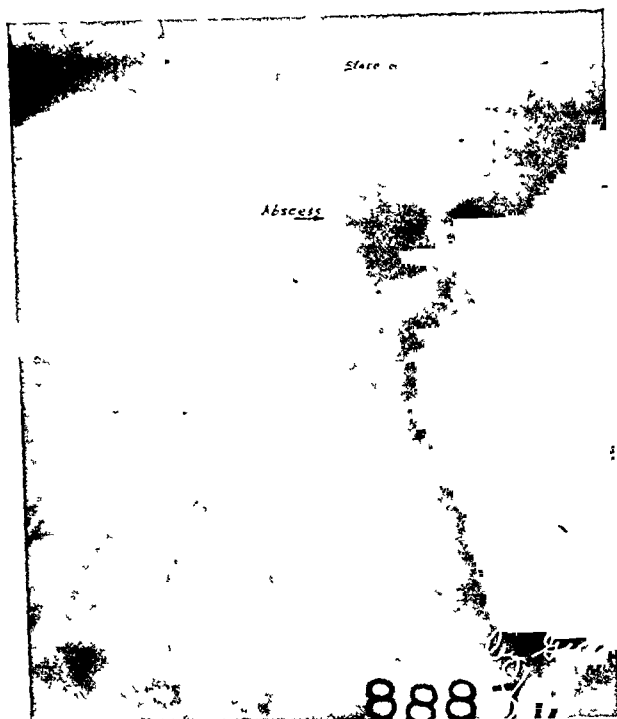


FIG. 3. Lateral view showing abscess after injection of 1 oz. of iodized oil into cavity. Its position in relation to sternum and vertebrae is definitely outlined.

decrease in the fatality rate, but also to be considered is the avoidance of a prolonged convalescence due to prolonged suppuration which is exhausting and increases the mortality in those who have stood the shock of open operation.

Since between 80 and 90 per cent of amebic abscesses are sterile as far as pyogenic organisms are concerned, aspiration gives little chance for secondary infection, although secondary infection is practically unavoidable following an open operation and drainage. It should be remembered that a large amebic abscess of the liver offers a favorable medium and optimum temperature for the growth of organisms is introduced by the aspirating needle or subsequent to incision and drainage.

The treatment of amebic abscess should differ little from that given tuberculous abscesses elsewhere. In both conditions one expects to find an abscess fluid sterile as far as pyogenic organisms are concerned. And in both conditions, aspiration will be



FIG. 4. Drainage of liver abscess by anterior incision. Immediate results satisfactory but hernia in epigastric region followed and dense adherent scar formed between abdominal wall and anterior surface of liver, over an area 4 in. in diameter.

The open operation, that is, incision and drainage, has a definite place in selected cases of amebic abscess. If cultures of aspirated pus show pyogenic organisms, incision and drainage will probably be found necessary. If in spite of repeated aspirations the temperature remains septic, and the leucocyte count remains high, incision and drainage may be the only procedure which offers hope. The location of the abscess may determine the method to be followed. Open operation may be indicated in abscesses of the left lobe of the liver and in those of the epigastric region because of the danger of injury to large vessels or abdominal viscera from attempted aspiration without incision. Open operation is also indicated when rupture of the abscess occurs into the pleural or peritoneal cavity and secondary infection occurs. The indications for open operation are as follows: Those

patients showing continuation of acute symptoms which have not been relieved by aspiration plus emetine should have the



FIG. 5. Amebic abscess of liver due to *entameba histolytica*. Abscess involved entire left lobe of liver with hardly more than liver capsule about it. Patient died of suppurative pericarditis due to direct extension or to small rupture through pericardium. At post-mortem examination no rupture could be found.

benefit of an open exploratory incision, although it should be carefully considered that the immediate shock will be severe, and that secondary infection will probably result, that convalescence will be prolonged and that the subsequent exhaustion will carry off some who were able to withstand the shock of the operation. The open operation should be necessary in exceptional cases, as statistics show that the abscess will be found in the right lobe in over 80 per cent of cases, in which case the abscess can be aspirated safely with the aspirating needle.

The signs and symptoms may give definite indications of suppuration and definite signs of localization. Frequently however suppuration is present without certain evidence of localization. The diagnosis must be confirmed and the first treatment rendered by the aspirating needle. The importance of a thorough knowledge of the anatomy in the normal, as well as a visualization of the altered anatomical relations resulting from the hepatitis, must be kept in mind. The point at which the aspirating needle is inserted depends upon the probable location as determined by the localization of pain and tenderness and by signs of localization

as revealed by the roentgen ray picture. If no localizing signs can be found the needle should be inserted in the eighth or ninth intercostal space of the right side and at least five regions of the right lobe explored before giving a negative report. This should be repeated a few days later if the symptoms continue. It is seldom necessary to have a needle longer than four inches, and except in a large individual, the insertion of a needle deeper than four and a half inches carries with it a risk of injury to important structures. Infiltration anesthesia is needed only for the chest or abdominal wall as the patient experiences very little pain when the liver itself is punctured.

When the abscess is located, aspiration may be done with a large glass syringe, by a Potain aspirator or by connecting the needle to a rubber tube running to a water pump or other suction apparatus. While some advise the injection or irrigation of the abscess cavity with quinine or emetine solution, there seems to be no indications for such procedures.

If open operation seems indicated the position of the abscess determines the site of incision. If localized in the right lobe it is accessible by the transpleural route, with or without rib resection. If the signs and symptoms point to suppuration in the left lobe or near the midline, a median incision will give the safest and best exposure.

Whether repeated aspirations or aspiration followed later by incision and drainage is the method of treatment decided upon, the definite localization of the abscess cavity by injection of iodized oil is a valuable aid for future use and may be a time-saving and shock-preventing measure. It is evident from observations made possible from the injection of the iodized oil, that collapse of the cavity apparently occurs as the pus is aspirated. Figure 1 shows a cavity now only large enough to contain approximately 1 ounce, which originally held only a few moments before  $4\frac{1}{2}$  ounces. This collapse is probably due to the formation of a vacuum

as the pus is withdrawn, with resulting diminution in the size of the cavity. This would probably not occur in open operation. Rapidity of absorption from the abscess cavity was determined by the repetition of x-ray pictures forty-eight hours later. After forty-eight hours only a small indefinite shadow remained to show the position of the ounce of iodized oil which had been injected, the remainder of the oil, to all appearances, having been removed by the hepatic ducts.

Whatever operative procedure is determined upon, the necessity for intramuscular injections of emetine hydrochloride in one grain doses before and during convalescence is essential. Daily intramuscular injections of emetine in one grain doses for the first ten days, half grain injections for four more days and one grain injections at weekly intervals for four more weeks with careful observations for evidences of toxicity, should result in continued improvement. While there may be some danger of emetine poisoning, amebic abscess of the liver is a dangerous condition and requires the administration of the emetine to the upper limits of safety. Ipecacuanha orally should be administered. Emetine bismuth iodide or other preparations of ipecac may be found less disagreeable by the patient following the administration of emetine and after the acute stage is past. Strovarsol, treparsol, yatren and other preparations have found favor with some and may be useful in resistant cases.

Recurrences of amebiasis and of hepatic abscess are common. The absence of ameba or of cysts in the stools is not sufficient evidence of complete recovery. There is no more reason to hope that a case of long-standing amebic infection is cured by one course of emetine than that a case of long-standing syphilis is cured by one course of antiluetic treatment. The repetition of courses of emetine hydrochloride in 1 grain doses intramuscularly or ipecac in 30 to 40 grain doses orally is of importance at intervals over a period of months, if future hepatic and

intestinal symptoms are to be prevented; just as in syphilis a small percentage of patients will be found in whom the treatment has no lasting benefit and where relapses will occur.

#### SUMMARY

In amebic abscess of the liver the two procedures, emetine without drainage, and incision and drainage, have a definite place in a small percentage of cases, yet the routine adoption of aspiration plus emetine, unless contradictions are present, is the most satisfactory method both from the surgeon's and the patient's viewpoint, and is a life-saving procedure.

The use of iodized oil for injection into the amebic cavity immediately following aspiration definitely localizes the abscess, giving its relations to other anatomical parts and making later aspiration or later incision and drainage much easier. The importance of immediate roentgen-rays in two planes must be emphasized, as the iodized oil may not be visible after forty-eight hours.

It is important that emetine and ipecac not only be given during the acute stage, but during and following convalescence if recurrences are to be avoided. The absence of ameba or cysts in the stools cannot be taken as an index of cure in hepatic involvement of the liver, and treatment should be continued at intervals over a period of months.

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# EARLY SYMPTOMS AND DIAGNOSIS OF CANCER OF THE GENITOURINARY ORGANS\*

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## KIDNEY

**A**DENOCARCINOMA or hypernephroma, the most common malignant tumor of the kidney, is rarely diagnosed early. Patients remain in ignorance of their condition for long periods because of the remarkably "silent" nature of the disease. Though the growth may be developing steadily, the excretory function of the kidneys may continue undiminished for years. Relative inaccessibility of the organs prevents a prompt recognition of an early alteration of form.

Sooner or later, however, in the great majority of cases the renal pelvis is invaded, and when ulceration takes place hematuria follows. This is the first symptom in about 85 per cent of all cases. It is at this time that the true nature of the disease should be discovered.

The initial symptom in other cases may be (1) pain in the kidney region; (2) discovery by the patient of a large tumor on one side of the abdomen; (3) loss of weight and strength; (4) discomfort caused by metastases.

Hematuria in these cases may be painless, associated with no localizing sensations. Often however, when blood clots form, there is spasm of the ureter of the affected side and the symptoms simulate those of a ureteral calculus in passage. Again, if a clot occludes a ureter, dilatation of the renal pelvis causes a characteristic unilateral pain in the flank. As relief follows promptly when the clot is evacuated into the bladder, hydronephrosis may be suspected. A clue is furnished if a pipe-like clot, formed in the uterine lumen, maintains its integrity after passage through the urethra.

The usual patient is an elderly person in depreciated general health. Palpation

of the abdomen reveals frequently an enlarged kidney. This finding is substantiated when a roentgenological examination is made in search of demonstrable calculi.

A careful cystoscopic examination is necessary in all cases. Even when the diagnosis can be made on the basis of an enlarged kidney in a patient suffering with hematuria, one should employ the cystoscope to learn the functional capacity of the sound organ. A common problem is presented by those patients who complain of hematuria without any localizing symptoms or signs.

Cystoscopy reveals usually a normal bladder and trigone. Occasionally this cannot be demonstrated until after the evacuation of blood clots. In rare instances the tumor sends an extension down the ureter without involving its walls. If this projects from the ureteral meatus it may be visualized as a pale, cylindrical protrusion. Should the patient be bleeding at the time, the task of the examiner is simplified because red jets will be seen issuing from the ureter of the affected side. Gentle catheterization of the ureter should be performed and specimens of urine collected from each kidney. Finding a few red cells blood is of no moment, but it is significant if trauma by the catheter causes appreciable hemorrhage, or if there is unilateral pyuria or subnormal urea output. It should be born in mind that renal calculi and hydronephrosis may coexist with a tumor, and that a bloody urine observed spurting from a ureteral meatus may contain pus cells from a tuberculous infection.

Searching the stained sediment after centrifugalization for tumor cells is fascinating but fraught with diagnostic pitfalls.

\* From the Department of Urology, the Memorial Hospital, New York. Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, November 21, 1928.

Positive findings by even the most expert cytologist may be erroneous. The writer needlessly removed a kidney, the source of slight bleeding, because tumor cells had been found in the stained sediment. All precautions had been taken to avoid error. The catheters had never been used previously and the report was given by a pathologist of eminence. Serial sections of the kidney were required to demonstrate a tiny area of adenoma of the lowest grade of malignancy.

The excretory function of the kidneys should be studied individually after the intravenous injection of phenolsulphonethalein. Early in the course of the disease there is no diminution in dye output. Somewhat later the output of the affected organ is decreased. Total output usually is normal because the sound kidney increases in function as rapidly as disease destroys its mate.

The pyelogram furnishes data of the greatest diagnostic value. The natural tendency of adenocarcinoma of the kidney is to invade the pelvis. For this reason the pyelogram shows a filling defect of greater or less degree in most cases. Early there may be nothing more than a distortion of the pelvic outline. Later, tumor tissue fills the pelvis, in some cases so completely that the contrast medium can be distinguished only when the roentgen rays strike the fluid tangentially.

After the renal tumor has been revealed roentgenograms should be employed in a careful search for metastases. These occur most frequently in the lungs, long bones, especially of the lower extremities, and bony pelvis. From a point of origin in the medulla the metastasis develops relatively rapidly and with remarkable invasive qualities. Its extension is characterized by complete bone destruction. If the end of a long bone is involved, the process may extend into the joint and through it, involving adjacent bones and even soft parts by direct extension. Metastasis to the lungs through the blood stream gives the roentgenological features noted in metastases from osteogenic sarcoma.

#### BLADDER

The symptoms of carcinoma of the bladder are usually well marked though not specific in this disease. More than 80 per cent of our patients were performing their usual duties with no premonition of illness when they were startled by the knowledge that they were voiding bloody urine.

No one can emphasize the fact too thoroughly that the symptom of hematuria is positive evidence of organic disease somewhere in the genitourinary system. In every case all proper diagnostic measures should be persisted in until the source of the hemorrhage has been discovered. With competent urologists available to nearly all, a physician assumes an unjustifiable responsibility in prescribing a urinary antiseptic and a period of observation. Only too often the hematuria stops promptly, the patient becomes reassured, but the cancer continues its development.

Coincident with hematuria in some cases, later in the majority urinary frequency is noticed. Before long dysuria sets in.

This sequence of symptoms occurs because the tumor originates in the bladder, most frequently at the base, and continues to develop until its growth at some point outstrips its blood supply. Necrosis destroys the integrity of a vessel wall and hemorrhage follows. In the neighborhood of a growing tumor the bladder wall at first is congested. Later it becomes infiltrated by inflammation or cancer. These changes decrease the bladder capacity and heighten its irritability. The earliest pain in the bladder may be caused by infiltration of its wall, infection, or obstruction by blood clots or tumor. At first the pain is noted only when the bladder contracts during micturition.

In a number of cases frequency and dysuria precede the appearance of blood. When this occurs the tumor is found in the neighborhood of the bladder neck. On account of the greater sensitivity of this region, infiltration causes symptoms of irritation to arise before the tumor breaks down and bleeds.

It is not within the scope of this paper to consider the symptoms associated with the more advanced disease.

In the examination of a patient the act of micturition should be observed closely. In this way information may be gained as to the degree of obstruction, the intensity of dysuria, the amount of hematuria, the period at which these are at their maximum, and the capacity of the bladder. If the odor of the urine is characteristic of putrefaction, we know that necrosis is taking place. The urine is referred to the laboratory for a complete analysis. However, all of these factors are of secondary importance and of no specific diagnostic value. The bladder base is palpated by rectal or vaginal examination in order to learn whether or not the bladder wall has become infiltrated. Occasionally bimanual touch can detect pericystitis or extension of the tumor into the pelvis.

In practically all cases it is through use of the cystoscope that definite and detailed information is gained. With many patients a cystoscopic examination is difficult. Nevertheless if spinal anesthesia is employed to render the operation painless, and suprarenalin be added to the irrigating fluid to diminish bleeding, a good view of the interior of the bladder may be obtained. Perhaps the most valuable factor in the prevention of hemorrhage is gentle manipulation of the instrument. The amount of residual urine liberated by the cystoscope is a measure of the obstruction at the vesical neck.

The tumor may be either papillary or flat. The usual picture is that of a cauliflower-like projection into the bladder cavity from some part of the bladder base. The lower third of the lateral walls is involved frequently by direct extension. The tumors are single or multiple, and of almost any size. In general configuration a simple papilloma is an elongated process with elongated, pointed villi, growing from a relatively small base. In contrast, the papillary carcinoma is a rounded tumor,

the individual villi of which are rounded or club shaped. The base is broad. In addition, the mucous membrane shows a considerable degree of inflammatory reaction in the neighborhood of carcinoma. Surrounding the tumor base there is usually a zone of bullous edema. This subsides through the various phases of congestion as the distance from the tumor increases. Most papillary cancers are reddish pink, but this is obscured frequently by white fibrinous exudate and grey slough, the latter sometimes impregnated with calcareous deposits. Extensive slough is characteristic of carcinoma.

A tumor on a long pedicle usually is benign. The pedicle of a malignant tumor becomes infiltrated relatively early. This causes contraction and shortening to such a degree that the growth often appears sessile.

Flat carcinomas of the bladder are characterized by extensive submucous infiltration with relatively insignificant surface changes. Often the cystoscopic picture is difficult to interpret. No tumor projects into the bladder cavity. Careful search must be made for greyish or yellowish-white ulcers in a field of intense congestion before a diagnosis can be hazarded.

In every case a biopsy should be performed. It is important to classify the tumors as to type and degree of malignancy. Whenever possible the specimen should be removed from the base of the carcinoma, for it is here only that information can be obtained relative to the presence or absence of infiltration.

The information obtained by cystoscopy is supplemented materially by the cystogram. When the bladder is filled with air and stereoscopic films are taken, a beautiful picture reveals the diseased viscus as a whole. Papillary tumors are seen projecting into the vesical lumen, while the infiltration accompanying the flat type prevents expansion. This is shown by a characteristic deformity.

A search for skeletal metastases should always be made. Usually it is sufficient

to obtain films of the lumbar spine, pelvis and femurs, although we have found secondary deposits in all of the long bones, scapulae and the skull. Metastases from bladder carcinoma are demonstrated as areas of bone destruction. It seems probable that the flat carcinomas metastasize more readily than do the papillary tumors.

#### PROSTATE

Carcinoma of the prostate rarely occurs in men under forty; nevertheless the possibility of the disease must be born in mind whenever a man of middle age presents urinary symptoms. If rectal examinations were performed periodically upon all men over fifty it is likely that something would be accomplished toward improving the prognosis of the disease.

Prostate cancer is not rare. It comprised 17 per cent of all cases of prostatic enlargement and 4.7 per cent of all urological cases seen by Young. The same authority suggests that four men in every 100 over sixty years of age will acquire the disease.

In the great majority of cases the first symptoms are those of bladder obstruction. They begin most insidiously. In fact the disease may be present for some time without causing any symptoms whatever. If the carcinomatous growth is superimposed upon benign hypertrophy of the prostate, as was demonstrated by Geraghty in 61 per cent of his cancer cases, the symptoms are those of the benign lesion. If the malignant disease occurs alone, symptoms depend largely upon the part of the gland involved.

In most cases nocturnal frequency occurs first. Slowly it becomes more annoying. After a time there is difficulty in starting the stream and the flow of urine can be maintained only by conscious effort. Frequency by day becomes established. The patient sometimes feels that in spite of his efforts to void he is not relieved completely. If nothing is done to improve the situation, dysuria sets in, at first in the bladder region and along the course

of the urethra. Later pain is more constant, low in the back or in the thighs. Occasionally there is hematuria.

The symptoms of frequency, difficult urination and dysuria are the result of an obstruction in the posterior urethra due to the carcinoma, to the associated benign hypertrophy of the prostate, or to a combination of carcinoma and inflammation. Infection of the bladder regularly follows obstruction, and the symptoms are aggravated when this occurs.

Pain low in the back, in the penis, perineum or rectum is caused usually by the presence of a large, congested tumor. When radiation is felt along the thighs, perhaps as sciatica, it indicates involvement of or pressure upon nerves of the pelvis. The localization of pain in more remote parts of the body suggests metastases. It is remarkable how extensive metastases may become without causing pain. We have seen patients with bones literally riddled who felt no discomfort at all.

Extension of the disease involves the seminal vesicles rather early because of compression posteriorly of the fold of dense pelvic fascia (Denonvilliers). In some late cases the growth infiltrates the bladder base, and may progress further, involving the anterior bladder wall. More rarely there is extension into the rectum.

The diagnosis of prostate cancer is made usually by rectal palpation. If the patient is placed in the lithotomy position and a metal sound is passed into the bladder, rectal touch may elicit more information than if the usual knee-chest position is employed. Urinalysis furnishes data of no diagnostic value. The cystoscopic picture is not characteristic although congestion and bullous edema of the bladder base are seen with some regularity.

Most commonly the prostate is large and densely indurated. More rarely the gland is of stony hardness but not especially enlarged. The shape is irregular; few of the normal landmarks persist. Nodules usually can be felt here and



there. Firm pressure causes no alteration in the remarkable fixity of the organ. Above the prostate induration can be detected frequently extending into and involving one or both seminal vesicles and passing laterally in many cases beyond the vesicles into the pelvis.

Such a picture of well established cancer is not an unusual finding when the patient first seeks medical advice. On the other hand, we feel prostates occasionally in which it is impossible by palpation alone to determine the nature of a single small area of increased density. For such cases a biopsy needle has been devised. With this instrument we have obtained positive evidence of value in about 60 per cent of our attempts. Recently, quite by accident, another test was found which may prove useful. Two patients who had prostates typical of benign hyperplasia were treated with high voltage roentgen rays. At the end of six weeks there had been such a reduction of inflammatory swelling that indurated nodules of carcinoma stood out in bold relief.

To complete the examination, films should be taken of the lumbar spine, pelvis and femurs in search of metastases. These lesions appear usually as areas of bone proliferation or increased density. In our experience, hypertrophic osteoarthritis of the lumbar spine occurs in a large proportion of patients who have cystitis as the result of obstruction by a benign hypertrophy of the prostate. In some cases it is difficult to differentiate the roentgenological picture of this disease from the osteoplastic metastases of a prostate cancer.

#### TERATOID TUMORS OF THE TESTIS

In a disease which may progress so rapidly to a fatal issue it is of the greatest importance that a correct diagnosis be made promptly. It is noteworthy that in our series of 124 cases, 43 per cent consulted physicians within a month of the time the first symptom was discovered. Seventy per cent sought medical advice

within the first six months of the disease. However, the correct diagnosis was made so rarely, and for this reason so much time was lost with ineffective treatment, that when seen first at the Memorial Hospital only 11 per cent were found free from local recurrences or metastases.

The diagnosis of teratoma testis is not an easy one, but it would be made with greater frequency if physicians examined intrascrotal tumors with the possibility of malignant disease in mind. In every case of testicular tumor a careful search should be made for metastases. Conversely, whenever a man presents symptoms or signs suggestive of intrathoracic tumor, or if there is a retroperitoneal mass, or a nodule in the left supraclavicular fossa, the scrotal contents should be examined.

Teratoid tumors of the testis must be differentiated from all other intrascrotal enlargements; but the diseases which resemble them most closely are gumma of the testis, hydrocele, hematocele, and more rarely tuberculosis of the epididymis.

When seen early in the course of the disease the patient is a man usually under forty years of age. He complains of a painless swelling of the testis. Inspection reveals a unilateral enlargement without any visible inflammatory involvement, although if the tumor is large the skin may be tense. There is no apparent retraction or shortening of the penis as is seen so frequently with a hydrocele, due to an elevation of the skin at the base of the penis. Examination with transmitted light reveals the solid nature of the tumor. Palpation discloses a testicular tumor, the epididymis rarely being much enlarged. The shape of a normal testis is maintained usually, owing to the density of the tunica albuginea. The consistence in general is firmly elastic, but on account of variability in the make-up of the tumor, some portions may be stony hard, indicating cartilage or bone, while elsewhere the fingers may sink into cystic depressions. In some cases fluid is present within

the tunica vaginalis and the examination is rendered more difficult. This fluid may be aspirated without danger of disseminating cancer cells provided the tunica albuginea is not punctured. A bloody fluid indicates that the epididymis has become involved because hemorrhage of the testicular tumor is confined within the tunica albuginea.

At the upper limit of the swelling there is usually a well-defined line of demarcation and an apparently normal spermatic cord may be felt. Very rarely the cord is sausage-shaped owing to direct extension of the disease. If pulsation of the spermatic artery can be detected, the vessel is unusually large, and a malignant tumor may be suspected. The patient seldom complains when the testis is manipulated; even a purposeful squeeze rarely elicits pain.

After the details of the primary tumor have been ascertained, the examiner should palpate the abdomen, especially of the same side, and the left supraclavicular fossa. A pelvic examination per rectum also is necessary.

Gumma of the testis often cannot be differentiated from an embryonal teratoma by the sense of touch. Clues as to the true nature of the condition may be obtained from the patient's history, but we rely especially upon the Wassermann test. With gumma a positive report is almost invariable. Of course a syphilitic may develop a teratoma.

Tuberculosis is predominately a disease of the epididymis. Most commonly there is a swelling of the epididymis in which nodules can be detected. Demonstration of characteristic changes in the prostate and seminal vesicles usually clinches the diagnosis. By contrast, the infrequent teratoma which invades the epididymis is likely to reach larger dimensions in a short time, be free from nodules, and show no marked inflammation or tenderness.

The abdominal metastases of teratoma testis are deeply situated. They feel rounded, solid and immovable, although

sometimes they pulsate with the aorta. They do not conform to the shape of renal or splenic tumors, and cannot be grasped bimanually owing to their fixed retroperitoneal position. Tympany by percussion may be elicited over these masses, and if on the left side, inflation of the stomach covers the swelling.

In addition to a thorough physical examination, a roentgenogram of the chest should be made in search of metastases in the lungs or mediastinum. Such a film may reveal clean cut rounded masses in the mediastinum. These appear to be the result of direct extension of the disease up the prevertebral lymph channels. Metastatic deposits in the lungs are characteristically dense, clean cut, and round or ovoid. The shape indicates invasion by way of the blood stream and their development within veins.

If all other diagnostic measures have been exhausted and doubt still exists concerning the nature of the testicular tumor, it should be subjected to a therapeutic test. An erythema dose of high voltage roentgen rays delivered to the center of the mass causes a rapid regression in the size of the great majority of teratomas. If the tumor is made up of radioresistant adult tissues, there is no appreciable response.

#### EPITHELIOMA OF THE PENIS

Penis cancers originate almost invariably beneath a tight, redundant prepuce or one seldom retracted and cleaned.

Clinically there are two types of the disease, the papillary and the flat. The latter is deeply indurated. From the histological standpoint, each is a squamous carcinoma.

The papillary tumor takes its origin from single or multiple warty excrescences which grow rather rapidly in size, increase in number, and later become confluent. After a time part of the tumor breaks down forming a necrotic crater. As a result an acrid, foul smelling, purulent fluid is discharged from beneath an inflamed

prepuce. The tumor spreads by gradual involvement of contiguous structures and at the same time it penetrates more deeply.

The flat type, which constituted 56 per cent of our cases, begins as a rounded erosion with slightly elevated edges. It extends laterally. At all stages this tumor is characterized by its dense induration. Ulcers appear as shallow excavations, yellowish in color. A foul discharge is present.

It is noteworthy that although phimosis and chronic balanitis with their attendant irritation have been present for years, when the cancer appears, practically every patient recognizes the condition as something decidedly different, even if its nature is not appreciated. Moreover, in every case in which the growth could be exposed, the area of true epithelioma was quite small when it was noticed first.

In a series of 75 cases, the first symptom of 73 per cent of the patients was a small sore on the penis. Nine per cent were aware of increased irritation soon followed by the appearance of a small sore. Five per cent suffered from paraphimosis, circumcision revealing a carcinoma. Five per cent first saw warts beneath a tight prepuce. When leucoplakia precedes cancer of the penis the patients notice an area of "scaly skin" or what appears to be a "corn." Occasionally the first intimation of the disease is a hard nodule situated in the distal third of the penis. When it is impossible to retract the prepuce to afford a thorough examination of the lesion, a dorsal slit or lateral incisions should be made. Care should be taken to avoid cutting through cancerous areas.

Of the more common lesions presenting an appearance similar to that of epithelioma of the penis may be mentioned various manifestations of syphilis, papillomatosis of the penis, granuloma inguinale, and certain chemical reactions such as those caused by bichloride of

mercury or the cresol derivatives. Sometimes it is extremely difficult to differentiate these conditions with certainty, especially when the original appearance has been altered by treatment. For this reason the diagnosis of carcinoma of the penis should be made histologically. We believe that a biopsy, carefully performed with a sharp razor, does little if anything toward hastening metastasis. No doubt in most instances a competent physician can make a correct clinical diagnosis; still the records show that much time has been lost following inappropriate therapy before the nature of the lesion was discovered. Moreover, following Broder's grouping of epithelial tumors, scientific treatment is based upon the intimate details of cellular structure and arrangement. This is revealed only by the microscope.

Metastasis occurs relatively late in the course of the disease, but inguinal adenopathy is a common finding. On account of early ulceration of the primary lesion and its environment of filth, the great majority of patients (85 per cent in this series), present palpably enlarged nodes at their first examination. Inguinal metastases usually can be differentiated from purely inflammatory nodules because of a greater degree of induration in early cases and later, when tumor growth has penetrated the capsule of the lymph node, the secondary cancer is fixed.

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# TUMOR OF THE BONY THORACIC WALL

## ASSOCIATED WITH TRAUMA LITERATURE AND CASE REPORT\*

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IN a recent paper on thoracic tumors Heuer stated that a total of about 240 cases of tumors of the bony thoracic wall had been reported in the literature. He referred to cases compiled by Parham (1898), Lund (1913), Hedblom (1921) and himself. He gave the following statistical summary:

Nearly 80 per cent of these were cases of tumors of the ribs and 20 per cent tumors of the sternum. One hundred and seventy-seven (86 per cent) tumors were primary; 4, probably primary; 11, secondary to tumors of the breast, and 13, secondary to other primary lesions. Pathologically, from 60 to 65 per cent were sarcomas, from 15 to 18 per cent chondromas and 11 per cent carcinomas. Benign tumors other than chondromas have been rare. A few cases included in the series were cases of inflammatory swellings. The difficulties in diagnosis have been the differentiation between benign and malignant tumors. The difficulties in treatment concern the wide opening of the pleura necessary in resection of the thoracic wall, the involvement of intrathoracic structures such as the lung and diaphragm and the secure closure of the thoracic wound. The operative mortality has been reduced from about 30 to about 15 per cent; in individual series it has been as low as 5 per cent. The late results leave much to be desired. The follow-up is given in only 67 of the entire series.

In the group of cases of malignant tumors there was freedom from recurrence in 19 at the time of the last report; but in only 3 of these did the freedom from recurrence extend beyond a three-year period. In the 3 cases there had not been a recurrence for four, seven and nine years respectively. In the group of patients with chondromas, 30 per cent are reported cured, but in many of the cases the period of observation had not extended beyond two years. It is apparent from this summary that the important considerations in this group of tumors are early diagnosis,

early radical operation and accurate follow-up studies.

In the light of this summary of the subject the following case seems of sufficient interest to merit a brief report.

### CASE HISTORY

R. B.: The patient, a colored man aged sixty-three years, entered the University of Virginia Hospital September 11, 1928. The family history was negative. When about thirty-seven years of age he had suffered with shortness of breath for a period of a month or more. At that time a large abscess had appeared on the lower part of his right chest in the posterior axillary line. After it had been opened and a large amount of pus evacuated, he had improved rapidly and soon recovered entirely. Six years before the time of his admission he had fractured some ribs on the right side.

The chief complaint was a large mass on the right side of his chest of three years' duration. He had first noticed it a few weeks after he had received a blow which fractured two ribs at the point where his ribs had been fractured previously. The mass had increased in size slowly and had not troubled him until about four months before the time he came for examination. During that period the mass had enlarged more rapidly and had caused some pain.

Examination revealed a well-nourished colored man. The temperature, pulse, respiration and blood pressure were normal. There was some opacity of the cornea of the left eye. The teeth were badly decayed. The heart and lungs showed no abnormality. On the right side of the chest there was an irregular mass about 10 cm. in diameter and protruding about 4.5 cm. above the surface of the chest. Its center overlay the costochondral articulation of the eighth rib. The tumor was very hard, nodular and firmly fixed to the ribs. About 10 cm. lateral to the outer margin of the mass was the old scar of an incision made into the

\* From the Dept. of Surgery & Gynecology, Univ. of Virginia. Submitted for publication Nov. 19, 1929.

abscess already mentioned. Examination of the blood and urine showed nothing abnormal and the Wassermann reaction was negative. Stereo-

it from the parietal pleura without injury to the pleura (Fig. 4). The defect in the chest wall was covered by the flaps of the skin alone and a



FIG. 1. Roentgenogram of tumor, lateral view.

scopic roentgenograms of the chest revealed a mass in the region of the costochondral articulations of the seventh and eighth ribs (Fig. 1). The tumor had expanded within the interior of the thorax and pushed aside the parietal pleura. The appearance of the tumor suggested osteochondroma rather than sarcoma. The patient was advised to have the tumor removed.

On September 14, 1928, I made a transverse, elliptical incision over the mass leaving a small area of skin attached to the growth (Fig. 2). Dissection revealed a mass which was an integral part of the seventh and eighth ribs. To remove the mass it was necessary to resect portions of the seventh and eighth ribs and their attached cartilages (Fig. 3). The mass projected into the chest cavity for a distance of about 4 cm., but it was possible to separate



FIG. 2. External aspect of tumor after its removal.

small rubber drain was placed in the dependent angle to remain there for twenty-four hours.

The pathological report described a solid, encapsulated tumor which included portions of two ribs and their cartilages. The mass measured  $11 \times 10 \times 9$  cm. Microscopically



FIG. 3. Intrathoracic aspect of tumor.

the tissue was an osteochondroma. It contained quantities of calcium and apparently arose in the costochondral junction (Fig. 5). The postoperative convalescence was entirely uneventful and the patient returned to his home on the twelfth day after operation. The wound had healed completely.

A follow-up letter was answered by the patient November 9, 1929, more than a year

after excision of the tumor. He stated that he was enjoying good health and that there had been no recurrence of the tumor.

formation may exist in certain cases but discredits the majority of such supposed cases and states five postulates which must

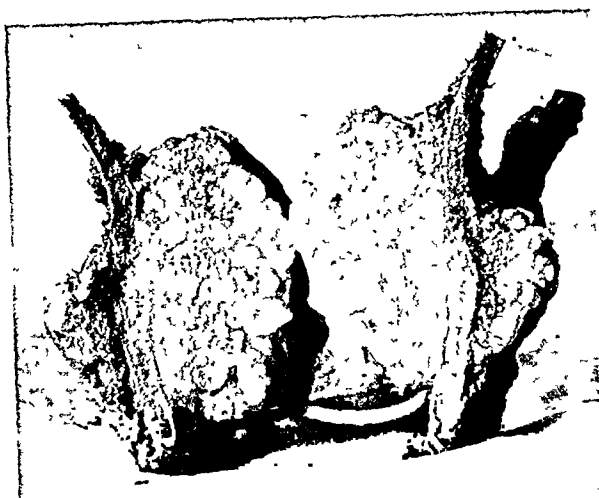


FIG. 4. Cross section of tumor. About one-third of the mass was within the thorax. Note the costochondral junction.

#### DISCUSSION

This tumor of the bony thoracic wall is of particular interest from the standpoint of etiology. Six years before the patient entered the hospital one or more ribs had been fractured at the site in which the tumor subsequently formed. Three years before his admission the same ribs had been fractured again and it was shortly after the second fracture that he first noticed the mass.

The relationship between trauma and the formation of tumors has been the subject of widespread discussion among pathologists for many years. An admirable review of the literature on the subject was made by Knox who concluded that a causative relationship between a single trauma and tumor formation had never been completely established. She mentioned the fact that it has never been possible to produce a malignant growth experimentally in animals by a single trauma.

Williams admitted the possibility of an osteochondroma arising from the cartilage cells in the callus following a fracture. Ewing apparently believes that a causative relationship between trauma and tumor



FIG. 5. Anteroposterior roentgenogram of tumor after it had been removed and sectioned.

be fulfilled in order to predicate a relationship:

1. The authenticity and sufficient importance of the trauma must be established.
2. The previous integrity of the wounded part must be established.
3. A reasonable time relationship, from three weeks to three years, must have existed.
4. The identity of the injured area with the site of the tumor must be established.
5. The tumor, microscopically examined, must be of a type that reasonably could be caused by trauma. Dermoids and other tumors arising from cell rests and so forth are thereby excluded.

The case herewith reported seems to fulfill the postulates. The facts stated in the history were volunteered and no factor of personal aggrandizement or compensation was present to vitiate the reliability of the statements.

That trauma, however, cannot bear more than a predisposing or secondary relationship to tumor formation is demonstrated by the fact that all trauma is not followed by tumefaction and that not all

tumors are preceded by trauma. In this case the trauma which fractured the rib or ribs at the costochondral junction may have displaced some cartilage cells which, when removed from their normal environment of restraining membrane and pressure relationships, commenced to grow unrestrainedly and finally formed the large tumor.

A somewhat analagous sequence of events seems to occur in the juxta-epiphyseal osteochondromata which occur along the ends of the shafts of the long bones, especially the femur, humerus and tibia. As the bone formation of linear growth at the epiphyseal line progresses, small islands of cartilage cells become stranded along the shaft and continuation of unrestricted development in these islands causes the formation of osteochondromata at the site. Ewing recognizes such tumors. In a recent article by Miller and Roberts the sixth illustration depicts a characteristic tumor of that type on the upper part of the humerus.

In this instance, repeated fracture of the rib or the separation of the costochondral articulation may have merely overstimulated the normal processes of repair in some such manner as to cause tremendous proliferation of tissue and the formation of the tumor.

Four months prior to the time of examination the tumor had begun to grow more rapidly. What the stimulus was can be no more than a conjecture. That it may have been a preliminary stage to the develop-

ment of malignant cells within the tumor must be considered, although no evidence of malignant change was found grossly or microscopically. The importance of prompt excision of such tumors of the bony thoracic wall is emphasized by this consideration and also by the extent to which the mass had invaded the chest cavity. Had the parietal pleura been intimately enough adherent to the tumor to necessitate entering the pleural cavity to excise the growth, the operation would have been much more hazardous than the extra-pleural excision proved to be.

#### SUMMARY

A brief statistical summary of tumors of the bony thoracic wall was given. The history of a case of osteochondroma of the chest wall was reported briefly. In this case there seemed to be a rather definite causative relationship between a single trauma and the formation of the tumor. Some literature on the subject was quoted and the case was discussed from that standpoint. The importance of prompt early excision of such tumors was mentioned.

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# PERIARTERIAL SYMPATHECTOMY IN CIRCULATORY DISTURBANCES OF THE EXTREMITIES\*

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IN 1921 there appeared an article by Lariche,<sup>1</sup> reporting his results from periarterial sympathectomy in 100 cases. In 1924 Arthur W. Allen of Massachusetts General Hospital published his results based on a smaller group of cases. Both of these reports were rather sanguine in their tone and gave the impression that much good could be expected from this new procedure.

Following these articles there was a mad rush on the part of many surgeons to use this method in treating all kinds of circulatory disturbances which included causalgia, painful amputated stump endarteritis, traumatic contractures, trophic ulcers, edemas and various ischemic sequelae. And, as a natural course of events, a widespread discussion on the circulation and vasomotor fibers to the extremities, was provoked, which resulted in the development of two schools.

The first group believed that the principal sympathetic nerve fibers accompany the main arteries which supply the extremities and form a network around them in the adventitial layer.

The second group believed that the sympathetic nerve fibers accompany the main nerve trunks which supply the extremities. Thus we have an apparent contradiction but not a real one, as it is an accepted fact that both of these sets of sympathetic fibers supply the extremities, and in order to get the best results a periarterial sympathectomy and nerve stretching must be done.

So numerous are the causes of leg ulcers such as eczema with its cutaneous and fat atrophy, infected ulcers following scratches, tuberculosis and lues, and last, but by no means least, trauma in the presence of varicosities, that the profession

has simply classified them as chronic ulcers without considering the underlying pathology. One only has to read of the myriad of methods suggested for the relief of these conditions, along with the categorical statements of the marvelous and everlasting cures recorded by one group of surgeons and the absolute failures, with the same methods, reported by other surgeons, to realize the chaos which exists at present in the treatment of so common a disease which seems to resist all human efforts.

There are several facts, however, which contribute to our failure in these cases. First, a disinterested and discouraged profession. Leg ulcers constituted no mean percentage of cases in the clinic while we were medical students. The greater portion of them were still uncured when we finished the course. What effect does this have on our profession? Those whom we looked to for instruction failed in their efforts to conquer this disease, with the result that in our subconscious minds we were fully convinced that such conditions could not be cured. We have continued treating them just as was done in the clinics, and with the same results.

Another cause of failure in the treatment of these ulcers is the fact that the underlying pathology has not been considered. We have failed to recognize the fact that all ulcers do not arise from the same cause. For example, one cannot expect to cure a luetic ulcer of the leg simply by increasing the blood supply to this part. Nor can one expect this operation to regenerate the walls of arterioles and capillaries when there is complete organic degeneration of the vessel walls.

But there are two types of ulcers in which this operation will definitely help,

<sup>1</sup>Lariche, *Ann. Surg.*, 1921.

\* Read before the Texas Surgical Society. Submitted for publication October 3, 1929.



namely, eczematous and varicose ulcers. Here there is no organic destruction in any part of the arterial blood system, but the pathology is in the venous system. So if we can increase our visat ergo and get an increased supply of fresh blood to the parts, we have reason to believe that the ulcers will heal. And this operation does supply fresh blood to the affected parts.

A brief discussion of the technic of this operation will demonstrate the means by which the operation produces a cure.

After preparing the extremity, we make an incision through the overlying structures to expose the vessel. Inspection readily demonstrates a thin covering around the vessel which contains the sympathetic fibers supplying the artery. This tissue is dissected away from the walls of the vessel around its entire circumference and for a length of about two inches. When sufficient amount has been removed the vessel wall has a glistening appearance. The first effect upon the vessel is a constriction which is very apparent during the operation. But this is temporary and is termed the "primary reaction" and is followed in a few hours by a dilatation of the artery, terminal arterioles and capillaries resulting in a definite arterial hyperemia which persists for a period varying from a few weeks to several months.

This hyperemia changes the appearance and condition of the limb from a cold blanched extremity to a warm pink one, in just a few hours. And the change is very apparent and definite.

We have used this method in a limited number of selected cases, but the results have been so satisfactory that the author wishes to make a preliminary report on his primary results and at a later date give you the end-results after a sufficient length of time has elapsed to enable him to determine whether the ulcer will return or not.

CASE I. White woman, fairly well nourished, consulted us for bilateral varicose leg ulcers which had resisted all treatment for six years. She had used all kinds of treatment including rest in bed, but the ulcer would heal

up to a certain point or would heal entirely, only to break down again when she got up and about. On January 25, 1928 a periarterial sympathectomy was performed on the right femoral. The characteristic changes appeared in a very few hours and on about the fourth day the granulation took on a red firm healthy appearance. No further treatment was instituted; only a vaseline gauze was applied every second day. By the end of four weeks the ulcer was entirely healed over.

On February 29, 1928 the same operation was performed on the other side and the progress of the case was the same as in the other leg: the ulcer was healed over in four weeks. This patient was kept in the hospital, made to walk around without any dressings and left the hospital seventy days after the last operation, with both legs healed over. A report sixty days later states that her legs are still perfectly well and she is able to go on with her house work.

CASE II. White man, varicose ulcer of one leg, five years' standing, with same history of having had all kinds of treatment including skin graft. His ulcer was deep. A periarterial sympathectomy was performed on him and in six weeks his ulcer was healed over. He left the hospital sixty days later without his ulcer. He was a regular attendant at the clinic but since he left the hospital we have heard nothing from him nor has he returned to the clinic, so we judge he has had no further trouble.

CASE III. A white woman with a large varicose ulcer of leg was given the same treatment, with the same results. She left the hospital in four weeks entirely cured. There was no subsequent report from her.

While we admit that such a small number of cases can not be taken as conclusive evidence that this operation is the treatment of choice in leg or arm ulcers, still our results have been so uniform and so perfect that we felt it worth your while to listen to our preliminary report of these cases.

We shall attempt to get in touch with these cases at a later date and also to get new cases and give you more information regarding the final outcome of these cases sometime in the near future.

# TREATMENT OF DIAPHRAGMATIC HERNIA\*

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IT IS only in recent years, with the improved methods of diagnosis, that nonstrangulated diaphragmatic hernia has been recognized early and treated by operation, resulting in the development of a successful surgical technic.

On account of the severity of the symptoms and the danger of strangulation, the radical operation by the abdominal route is the treatment of choice. The thoracic route is preferred by a minority of surgeons. When it is impossible to reduce the hernia from the abdominal side, it is necessary to make use of both incisions.

## THE ABDOMINAL OPERATION

The abdominal route is indicated when there has been injury to abdominal viscera and when there are symptoms of intestinal obstruction. It enables the operator to confirm the diagnosis promptly and in case intestinal resection is necessary, it affords the better exposure and permits a quicker repair. The patient suffers less from shock following laparotomy than after thoracotomy.

The patient is placed in the Trendelenburg position and the abdomen opened by an incision above the umbilicus in the midline, or by a lateral rectus incision, or by one of the gallbladder incisions. A free exposure is essential, and it is often advisable to carry the incision one or two inches (2.5 to 5 cm.) below the umbilicus.

On opening the abdomen, the operator will immediately notice that certain of the viscera are not in their normal position; the organs most frequently herniated are the stomach, transverse colon and small intestine. With the patient thoroughly relaxed under general anesthesia, the hernial opening in the diaphragm is exposed by wide retraction, and the hernia reduced by grasping the portion of viscera

still within the abdomen and making gentle traction on it; reduction may possibly be facilitated by placing the patient in a vertical position. If reduction cannot be accomplished, the hernial opening can be enlarged; this failing, it is necessary to open the thoracic cavity, free the adhesions and reduce the hernia. In Scudder's patient, a stomach tube was passed and the viscus emptied by compressing it in the chest; the hernia was then reduced without difficulty. Mayo passes a rubber tube into the chest through the hernial opening to relieve the suction force of breathing.

The principal disadvantages of the abdominal route are, the depth of the hernial opening, the impossibility of freeing extensive adhesions in the thorax, and the difficulty of preventing the viscus in the hernia from being drawn back into the chest with each inspiration.

The method of closure of the diaphragmatic opening depends on its size and location. If the edges of the opening can be brought together, the hernia can be closed with interrupted or mattress sutures of heavy chromic catgut, taking a deep bite in the muscle with each stitch; this closure can be reenforced by a second layer of sutures, either continuous or interrupted. Soresi closes these openings by taking a number of stitches on each side, parallel to the edge of the opening; these stitches are tied together on each side and then tied across, leaving a small opening at each end to be closed by purse string sutures.

If drainage of the pleural cavity is necessary, it can be secured by making a stab wound, with a sharp-pointed hemostat, passed through the diaphragmatic opening, and through the posterior part of the chest wall between the ribs, at the lowest point of the pleura. The line of suture of the diaphragm is often reenforced

\* Submitted for publication November 9, 1929.

by sewing a strip of fascia or a portion of the omentum or stomach, which has been in the hernia, to the edges of the opening.

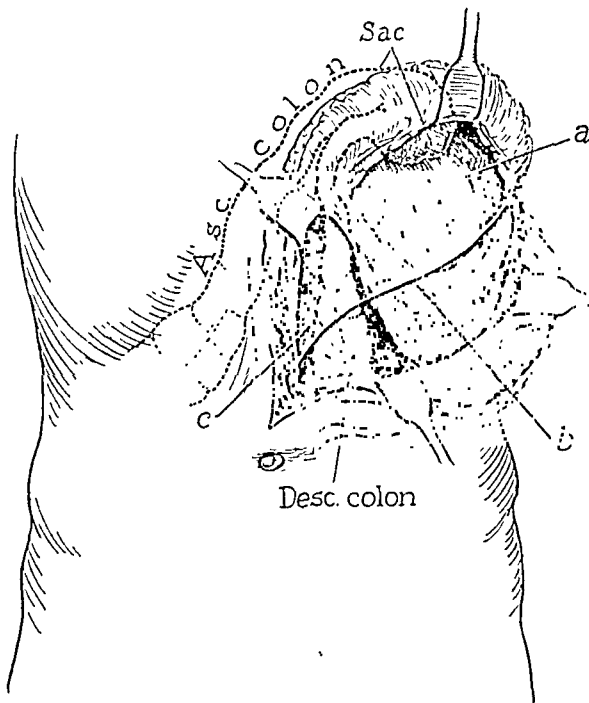


FIG. 1. The combined thoraco-abdominal incision for diaphragmatic hernia. The 6th and 7th ribs are shown resected. (a) The pleural cavity. (b) Line of skin incision. (c) The abdominal cavity.

If the hernia cannot be reduced, and the condition of the patient does not permit opening the thorax, a gastrojejunostomy can be done; if the transverse colon is in the hernia, the ascending and the descending colon can be anastomosed.

#### THE THORACIC ROUTE

The thoracic operation should be used when there is traumatic injury of the pleura, lungs, heart or blood vessels, accompanied by hemorrhage. The wound in the chest acts as a guide down to the hernia, which can be freely exposed simply by enlarging the wound.

The advantages of the thoracic route are: It is easier to deal with the hernia because it is nearer the surface than when approached from the abdomen; the hernia can be more readily reduced, and the adhesions to the pleura and pericardium can be freed; and it is less difficult to close

the hernial opening. If gangrene has already occurred, the thoracic route should be used first, because of the chance of perforation having occurred, and the danger of tearing the viscera in reducing the hernia. The abdominal viscera should be examined and treated through a laparotomy incision.

The patient is usually placed on the table in a lateral position. The intercostal space is widened by means of a pillow or sand bag under the chest. The incision is made in the eighth or ninth intercostal space and is 4 to 5 inches (10 to 12.5 cm.) in length. Strong retraction is made and the ribs widely separated. It is usually possible by this means to avoid the resection of one or more ribs. If the exposure is insufficient, it is necessary to resect the costal arch.

I believe that the best exposure is obtained by an incision which begins at the lower edge of the rib at the end of the xiphoid cartilage, divides the rectus muscle, and enters the intercostal space between the ninth and tenth ribs without opening the pleura.

The hernia is reduced, the excess of sac is folded upon itself and used as a pad to close the opening, or the sac can be resected and the edges overlapped and sutured. The edges of the hernial opening are brought together by interrupted sutures of heavy chromic catgut, or one of the methods of closure used in the abdominal operation can be used here.

When the opening in the diaphragm cannot be closed by ordinary means, it can be accomplished sometimes by resecting the ribs in front of the hernia. The danger of pneumothorax is generally overestimated; if the chest is opened gradually, the symptoms are slight. A differential pressure cabinet is unnecessary. If dyspnea appears during operation, the lung should be drawn down to the wound and steadied with a soft rubber covered forceps. Before completing the operation, one should insert into the pleura a small blunt trocar attached to a syphon bottle. At the

completion of the suture all the air in the chest can be readily aspirated, and the lung reexpanded.

If the chest has been opened under local anesthesia, the patient can be allowed to come out of the general anesthetic as soon as the diaphragm is closed; with assistance, he can close his mouth, hold his nose, and by blowing, expand the lung as the final suture is tied. If there is danger of infection, or if there has been an extensive separation of adhesions, a drain can be left in the pleura; however, when possible, the wound should be closed without drainage.

#### THE COMBINED THORACO-ABDOMINAL OPERATION

The combined operation is the treatment of choice in a great many cases; it is being used with increasing frequency. Often it is necessary to open both the thorax and the abdomen, to reduce the hernia and to deal with complications. Some operators prefer to open the thorax and then the abdomen by separate incisions; others use the single incision which exposes both cavities simultaneously.

Schwartz and Quénu recommend the combined thoraco-abdominal route in all cases. The incision begins in the axillary line and extends forward in the seventh intercostal space. The pleural cavity is opened, care being taken to avoid a too sudden pneumothorax or injury to hern-

iated viscera that may be adherent to the chest wall. The incision curves downward over the rectus muscle to the midline, and then down to the umbilicus. The peritoneal cavity is opened; the cartilaginous portion of the ribs, at the site of incision, is cut with scissors; and the incision continued in a straight line through the diaphragm to the hernial opening. The adhesions are separated, the viscera reduced, the margins of the opening freshened and sutured, the cartilaginous edges brought together and the wound closed. If necessary, a drain can be left in the lower part of the pleural cavity for two or three days. Auvray resected the ninth rib and continued the incision down to the umbilicus. He cut through the ninth costal cartilage and incised the diaphragm up to the hernial opening. The hernia is reduced, the opening sutured, and the wound closed.

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# CRANIOCEREBRAL INJURIES\*

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CRANIOCEREBRAL injuries are of very frequent occurrence. They make a large percentage of the accident work admitted to a general hospital. The group of 25 cases which I am reporting were consecutive admissions to the surgical service of Dr. Thomas J. Ryan at the Misericordia Hospital during a period of one year. It is my purpose in this review to outline our mortality, the method of treatment and give a short discussion of the sequelae. We have divided these cases into laceration of the brain and fracture of the skull. Only those cases are reported as fracture which were positive by x-ray findings. The cases which were diagnosed as laceration of the brain were negative for fracture by x-ray examination, but had bloody spinal fluid and alterations in the spinal fluid pressure. The cases were divided as follows:

	Number	Deaths	Mortality, Per Cent
Laceration of brain. . . .	9	0	0
Fracture of skull. . . . .	16	4	25
Total. . . . .	25	4	16

In reviewing the mortality in the literature during the past few years I find that Stewart<sup>1</sup> reported 617 cases with 322 deaths, a mortality of 52 per cent; McCreery<sup>2</sup> and Berry report 520 cases with 204 deaths, a mortality of 39 per cent; Djerup<sup>3</sup> of Copenhagen reports 57 per cent mortality. It is interesting to note the variance in these mortality figures. The 57 per cent mortality of Djerup is included in this discussion because it is his practice to operate on all cases which present any signs of increased intracranial pressure.

## PATHOLOGY

It is necessary to have a definite conception of the circulation of the cerebrospinal fluid in order to manage these cases intelligently. The fluid is secreted by the choroid plexus in the ventricular system and communicates with the subarachnoid space through the foramina of Magendi and Luschka. The fluid circulates in the subarachnoid space and is absorbed into the dural sinuses by the pacchionian bodies which are arachnoid villi projecting into the sinuses.

The early symptoms resulting from head injuries are dependent upon the damage done to the contents of the skull rather than to the skull itself. The injury to the skull is important if the fracture is compound or if it is depressed and causing symptoms. The pathology which exists in the brain varies from contusion and mild edema to petechial hemorrhages and extensive lacerations. There is no organ in the body in which the effects of pressure are so serious as in the brain, owing to the fact that it is confined in a bony case incapable of expansion. It is true that a slight increase in pressure may be compensated for by the communication between the cranial and spinal cavities; but this is limited.

The sequence of changes occurring in the circulation of the fluid as a result of these injuries has been well described by Jackson,<sup>4</sup> "As a result of trauma a local swelling of the brain soon arises at the site of injury and reaches its maximum in twenty-four to forty-eight hours. If the swelling is slight the interference with absorption of cerebrospinal fluid is only moderate and the intracranial pressure will return to normal in a few days. If, however, the local swelling is more marked the general effects will be more serious."

As the local swelling increases the cere-

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brospinal fluid is driven out of the cerebral subarachnoid space into the corresponding space in the spinal canal. The brain is pressed against the vault of the skull, the subarachnoid space is compressed and obliterated, and the absorption of the cerebrospinal fluid from that space stops completely. Circulation of the fluid ceases and stasis results. The accumulating fluids in the basal cisterns pushes the brain still more forcibly against the cranial vault, still more effectually interfering with absorption. As the brain is pushed upward the brain stem tends to plug the narrow incisura tentorii, so that the fluid accumulates in the basal cisterns and distends the ventricles, producing a form of communicating hydrocephalus.

#### TREATMENT

The treatment of these head injuries falls under the ten following divisions:

1. Shock.
2. X-ray.
3. Spinal fluid pressure.
4. Spinal drainage.
5. Glucose 50 per cent.
6. Magnesium sulphate.
7. Neurological consultation.
8. Eye consultation.
9. Otolaryngological consultation.
10. Operation.
  - (a) Compound fracture.
  - (b) Depressed fracture.
  - (c) Foreign body.
  - (d) Extradural hemorrhage.
  - (e) Intradural hemorrhage.

Upon admission the case usually presents symptoms of shock which are treated in the usual manner. No operation is performed at this time unless we feel that the condition present within the brain is adding to the amount of shock. Lacerations are debrided, the bone investigated and the scalp is sutured loosely. The blood pressure is recorded and spinal puncture performed. The spinal puncture is instituted as soon after admission as possible. The spinal fluid pressure is estimated

and the amount of fluid withdrawn is dependent upon this pressure. Frequent pressure readings are recorded during the withdrawal of the fluid to assure of free circulation. If the spinal fluid pressure is increased beyond 30 mm. Hg it is reduced 50 per cent; if it is below 20 mm. Hg it is reduced to normal. The spinal fluid pressure is estimated as frequently as symptoms demand, the attending physician being guided by blood pressure readings, mental condition and pulse rate. However, this reading is estimated at least once a day until the pressure returns to normal. If the fluid is bloody but not under pressure it is removed daily until it becomes clear. X-ray examinations are made as soon as the shock has subsided, although at times we have found it necessary to have this examination performed in order to confirm or outrule the diagnosis of a depressed fracture. Intravenous injections of 50 per cent glucose are given for the purpose of reducing intracranial pressure and at the same time acting as nourishment to the patient during the first few days when he may not be able to take food by mouth.

Magnesium sulphate is also given by mouth and rectum for the purpose of reducing intracranial pressure. Neurological consultation is instituted as an emergency procedure and we are guided to a considerable extent by the decision of the neurologist. We rely almost completely upon the deductions of our neurologist for the institution of operative procedures unless the indications are very evident upon admission, such as a compound fracture, a depressed fracture or foreign body. Eye consultations were originally performed within the first two or three days following admission, but we now find that more information can be gained by having this consultation at a later date. Otolaryngological consultation is always performed in the cases with discharge from the ears, nose or mouth. In regard to the late operations for these head injuries we are inclined to wait until

definite decision has been made by the neurologist.

#### SEQUELAE

The important complications which occurred in this group were blindness in the right eye in one patient with a fracture of the vault, weakness in the left arm in a patient with a depressed fracture which was operated, and left hemiplegia in a patient with a fracture of the vault. In 12 of these cases we have been able to determine the late symptoms over a period of from one to six months, although we realize that this is a short period of time to judge the late symptoms. We hope in the future to make a further contribution to this subject with relation to these symptoms and the intracranial pressure. Four of these patients have complained of persistent headaches, although they have all returned to the same occupation that they followed before the injury. In examining the literature of the late head symptoms we find that there is not a large group of cases reported. The question might arise as to the wisdom of treating these cases conservatively, but we are convinced from the study of the physiology and pathology of this condition that the treatment should be conservative and operations be performed only after considerable deliberation.

It appears from these reported cases that the late symptoms vary a great deal, but judging from the literature,

better end-results may be expected following conservative management.

	Cases	Head- aches, Per Cent	Dizzi- ness, Per Cent	Epi- lepsy, Per Cent
Jackson <sup>4</sup> .....	295	17	4	8
Strecker, E. A. <sup>5</sup> .....	30	80	..	23
Hanse, A. <sup>6</sup> .....	88	..	..	19
Dougherty, J. F.....	12	33	0	0

#### CONCLUSIONS

1. Conservatism in the treatment of cranioerebral injuries will probably show the best immediate and late results.

2. The intracranial pressure can in most cases be adequately controlled by the judicious use of spinal drainage in conjunction with a spinal manometer. The manometer should always be used in doing a spinal puncture.

3. A clear understanding of the pathology is necessary for the proper management.

4. Operation should not be instituted unless very definitely indicated.

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# GASTROCOLIC FISTULA\*

## BRIEF REVIEW OF LITERATURE AND REPORT OF CASE

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THE condition of gastrocolic fistula, or cologastric fistula as I prefer to call it in my case because the lesion originated in the colon, is sufficiently unusual to justify report of a case. The majority of cases of gastrocolic fistula occur as a sequel to posterior gastroenterostomy for jejunal ulcer. In the case reported, the condition was apparently primary carcinoma of the colon, which formed a fistulous connection with the stomach.

Verbrugge<sup>1</sup> in 1924 collected 202 cases of gastrocolic and gastrojejunocolic fistulae from the literature, including 7 cases previously reported from the Mayo Clinic, and added 14 new cases from the Clinic, making a total of 216. In 95 of these cases, the fistula resulted from a jejunal ulcer following posterior gastroenterostomy; in 121, from a primary organic lesion of the stomach or colon, chiefly carcinoma. The 70 cases reported prior to 1903 originated from cancer of the stomach or colon.

According to recent reports, to quote Verbrugge:

Fistulas due to cancer of the colon and stomach seem to be decreasing, whereas fistulas following gastroenterostomy are increasing. This can easily be explained by the fact that early diagnosis and intervention in cases of cancer of the digestive tract have reduced the number of these large tumors, whereas the more frequent use of posterior gastroenterostomy for gastric, and especially duodenal, lesions has increased the number of jejunal ulcers.

Of the 21 cases of gastrocolic fistula from the Mayo Clinic, 2 were due to cancer of the colon perforating into the stomach; 19 to jejunal ulcer following posterior gastroenterostomy. Fistulae in cases of carcinoma of the colon or stomach, Verbrugge notes, are part of the tumor itself. They are lined with tumor cells.

The most characteristic symptoms of gastrocolic fistula are diarrhea, foul eructations and vomiting of fecal material. Pain is not a usual symptom. Of the 21 cases from the Mayo Clinic, roentgenographic examination was made in 20. The findings were definitely positive for fistula in 11, doubtful in 1, and negative in 8. A clinical diagnosis was made in 13. Seven cases not diagnosed clinically were also not diagnosed by the roentgenographic examination.

Kuttner<sup>2</sup> in 1926 and Jansson<sup>3</sup> in 1928 both noted that roentgenologic diagnosis of gastrocolic fistula can sometimes be made by the use of the opaque enema, when the opaque meal fails to show the condition. By means of the enema, the fistula may be clearly demonstrated and the stomach may be seen to fill rapidly from the colon.

Recent case reports (since 1924) relate chiefly to gastrocolic fistula due to jejunal ulcers following gastroenterostomy. The following cases after carcinoma of the colon are reported:

Dickson<sup>4</sup> in 1928 reported 6 cases of gastrocolic fistula from the Toronto General Hospital, 2 of which were secondary to carcinoma of the colon:

In 1 case, the patient was a man fifty-two years of age, who, on admission to the hospital, was pale and sallow and complained of diarrhea alternating with constipation. He had had attacks of vomiting for the preceding two weeks, and more recently the odor of the vomitus had become fecal. A barium enema showed that the sigmoid and descending colon filled quickly. There was a circular filling defect in the transverse colon about 3 inches proximal to the splenic flexure. A fistula was demonstrated passing from the upper limit of this defect, through which the stomach was quickly filled. A diagnosis of gastrocolic fistula secondary to carcinoma of the colon was made. Operation was refused, but the diagnosis was later confirmed at autopsy.

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In the second case, that of a man forty years of age, the patient showed loss of weight, weakness, diarrhea and vomiting. These symp-



FIG. 1.

toms had been progressively increasing for the preceding six months. The vomitus was of the fecal type. A barium enema showed a filling defect in the same region as in the previous case. A definite fistula was demonstrable. It entered the posterior wall of the stomach. A second fistula was found passing into the jejunum. Laparotomy was done, but no repair was attempted, because of the patient's condition. Death occurred within six hours after operation. Autopsy confirmed the diagnosis of carcinoma of the transverse colon with gastrocolic and jejunocolic fistula.

Brock<sup>5</sup> in 1928 noted that a large majority of cases of gastrocolic fistula follow perforation of a jejunal ulcer after gastrojejunostomy. The second leading cause is malignancy of the stomach or colon. Although gastrocolic fistula is a rare condition, 4 cases were seen by Brock in rapid succession at Guy's Hospital, London. Three followed gastrojejunostomy and 1 a growth of the transverse colon.

In the latter case, the patient was a man thirty-nine years of age. For three months

prior to admission to the hospital, he had lost weight and strength. During this period he had an attack of diarrhea. He had vomited occasionally, the vomitus consisting of undigested food eaten two or three days earlier. Belching of foul gas was also a troublesome symptom. There was no pain, abdominal distention or palpable tumor. The vomiting and belching ceased soon after admission to the hospital. Samples of the vomitus and feces were identical in appearance, both being rancid, dark and fluid, and containing a little solid matter. Roentgenologic examination with an opaque meal showed a communication between the pyloric vestibule and the transverse colon. One opaque enema showed a dilated colon with the fluid passing as far as the middle of the transverse colon and then flowing into the stomach. At operation, the fistula was found; also, secondary carcinomatous nodules on the peritoneum. No attempt was made to excise the fistula. The patient died from bronchopneumonia twelve days after operation. At operation it could not be definitely decided whether the primary growth was in the stomach or in the colon, but at autopsy a large carcinoma of the transverse colon, which had ulcerated into the stomach, was found.

Brock notes that, including the 4 cases reported by him, there are records of 10 cases of gastrocolic fistula at Guy's Hospital. One case, that already reported in detail, followed carcinoma of the colon; 1, gastric carcinoma; and the others, jejunal ulcer resulting from gastrojejunostomy. Brock states that when gastrocolic fistula is due to carcinoma of the stomach of colon it is usually associated with advanced malignancy; but the history may be relatively short and obscure, as in his own case, in which no metastases were found except the secondary nodules on the peritoneum.

#### REPORT OF CASE

Mrs. E. L., aged forty-nine, was referred to me by her family physician in February, 1929, because of the presence of a definite mass in her abdomen. Her chief complaint was pain in the right shoulder. The family and past personal history was negative, and the present illness was of only four weeks' duration. However, her weight had fallen from 155 to 140 lb. in three months.

The patient was well nourished and seemed to be in good general health. Her breath was

extremely fetid, much more so than could be accounted for by a condition of oral sepsis. It suggested deep-seated putrefaction in the gastrointestinal tract.

There was a definite movable tumor in the left upper quadrant of the abdomen. The diagnosis of a neoplasm was confirmed by roentgen-ray study, which revealed an extensive filling defect in the distal portion of the transverse colon and a fistulous connection with the greater curvature of the stomach. This condition is shown in the accompanying roentgenogram.

Examination of the gastric contents gave normal figures for free hydrochloric acid and combined and total acidity. Lactic acid was negative and no Boas-Oppler bacilli were found.

Hemoglobin was 75 per cent and the red blood cell count in proportion. The urine was negative. Several blood pressure readings showed slight hypotension.

On February 27, 1929, laparotomy was performed at the Mt. Sinai Hospital by Dr. A. A. Berg. His findings corroborated the clinical and roentgenologic diagnosis: There was an adenocarcinoma of the colon with suppuration and a fistulous connection with the stomach through the gastrocolic ligament.

Operative finding: Large tumor in the transverse colon. This tumor had perforated into the mesocolon and omentum. It was adherent to the peritoneum and had ruptured into the stomach, with the resulting formation of a gastrocolic fistula. The colonic tumor was resected after its complete mobilization. The involved portion of the stomach was excised, and end to end anastomosis of the colonic ends and a repair of the defect in stomach was made.

There was an uninterrupted convalescence, the wound healed kindly, and the patient was discharged from the hospital about seven weeks after the operation.

#### COMMENT

In my opinion, this case represents primary adenocarcinoma of the colon, for the following reasons:

1. The carcinomatous involvement of the colon predominated considerably over that of the stomach.

2. The course of migration of the opaque medium was obviously from the colon to the stomach. After a barium meal, the tortuous opaque streak revealing the fistula was not observed. However, this

finding was apparent after a barium suspension enema when the medium was introduced under pressure.

3. The absence of symptoms referable to the stomach and the normal findings on analysis of the gastric contents indicate the absence of any considerable glandular involvement of the stomach.

To my mind, the extremely short duration of the illness in this case was more apparent than real. Patients of this type have a tendency to minimize their symptoms so as to obscure the real course of the malady. A fistulous tract connecting two adjacent organs through neoplastic tissue could not have been formed in so short an interval as the history might suggest.

The marked fetor oris is apparently to be ascribed to the condition of tissue breakdown associated with the fistulous tract. This case illustrates the general rule that roentgen-ray study is the only means by which exact preoperative diagnosis can be made in cases of gastrointestinal neoplasm and surgical intervention may thereby be rendered less speculative.

#### SUMMARY

Gastrocolic, or cologastric, fistula is a rare condition. Two hundred sixteen cases were reported up to 1924. In most instances the disturbance is a sequel of posterior gastroenterostomy for jejunal ulcer. It may result from malignancy of the stomach or, as in the case reported, from carcinoma of the colon.

In the case reported, the condition should be called cologastric fistula, because the malignant growth originated in the colon and formed a fistulous tract leading through the gastrocolic ligament to the greater curvature of the stomach. The case occurred in a woman, aged forty nine, who had a definite movable tumor in the left upper quadrant of the abdomen. Roentgenographic examination after an opaque enema under pressure clearly indicated that the course of the fistula was from the colon to the stomach. The findings were confirmed at operation.

[NOTE: For references see author's reprints.]

# MODIFICATION OF THE UNGER APPARATUS

## FOR BLOOD TRANSFUSION\*

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**D**URING the past few years several modifications of the Unger apparatus for whole blood transfusion have made their appearance. Most of these changes have not resulted in an appreciable increase in the efficiency, dependability or ease in manipulation of the apparatus.

The apparatus designed by Dr. L. G. Unger of New York City has been, for several years, the favorite apparatus of many surgeons who perform a considerable number of transfusions and who have mastered the technic of its use. In their hands, the method is very dependable. The technic is simple and any desired amount of blood can be transfused with ease and rapidity. However, many competent surgeons who perform a very few transfusions each month, are frequently confronted with at least an occasional failure. In many localities it is unjustly regarded as an impractical instrument.

As regards the original Unger apparatus per se, the principal causes of transfusion difficulties and failures are:

1. The sticking of the Record blood syringe due to the thin film of blood which gradually forms between the plunger and the barrel. This sticking is favored by the unequal heat expansion of the metal and glass and also by the small outlet of the syringe.

2. The small bore of the stopcock connections and of needle adapters retarding the ready flow of blood. Partial clotting is thus more likely to occur with resulting difficulties of withdrawal and injection of blood.

3. The Record blood syringe breaking as a result of falling from the stopcock.

4. The entrance of blood into the saline solution.

It is obvious that the above difficulties could be largely eliminated by:

1. Using a blood syringe having the barrel and plunger of the same material and a larger outlet.

2. Increasing the bore of the stopcock connections and of the needle adapters.

3. Using a bayonet lock connection for the blood syringe.

4. Practically eliminating saline solution.

The apparatus presented here has been satisfactorily used for one hundred transfusions at the Wyoming County Community Hospital. An attempt has been made to eliminate the causes for occasional failures. It is believed that the changes mentioned below have resulted in a more efficient and dependable instrument especially in the hand of the occasional operator.

A Record syringe is used for the injection of saline instead of a glass Luer syringe. Between its connection and the four-way cock, a one-way cock is placed. With one hand the assistant can easily turn the one-way cock and refill the syringe with saline, thus having his other hand free for other assistance such as holding an infant's arm, etc. In case the blood syringe is broken this Record syringe may be used as a substitute by inserting an adapter.

The transfusion syringe designed by Dr. John M. Scannell of Brooklyn is used for withdrawing and injecting blood, instead of a Record syringe. As it is constructed chiefly of glass, sticking of the plunger is lessened. It has a large outlet and is connected to the four way stopcock by a strong bayonet lock. As the metal ring of the Scannell syringe was unnecessary, it was removed. By means of an adapter, this syringe may be used for the injection of saline in case the Record syringe is broken.

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The bore of all parts (saline connection excepted) of the four-way cock and of the two needle adapters was increased to 2.5

the patient's home. It is perfectly adaptable to the method of blood transfusion as advocated by Dr. O. A. Brines of Detroit.

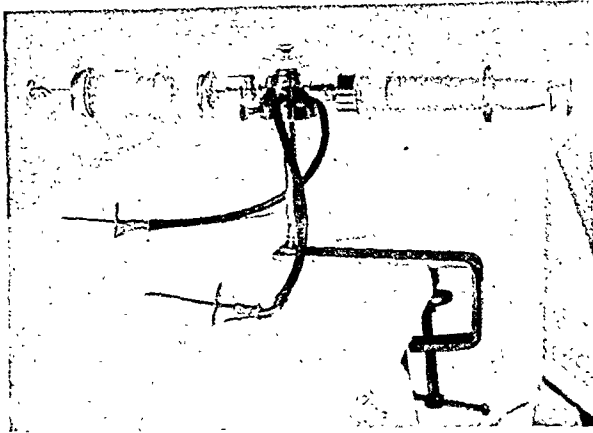


FIG. 1. Apparatus assembled.

mm. The metal disks of these adapters were increased to 11 mm. to permit a better grasp should the necessity arise of changing the rubber tubing during the course of a transfusion.

When the transfusion is underway satisfactorily the use of saline solution is discontinued. The use of ether spray upon the blood syringe to retard the clotting time and the expansion of the syringe is not objectionable when employed as a very fine spray. The increased bore of the apparatus and the use of the Scannell syringe have practically eliminated the necessity for saline solution and ether except in unusual cases where the actual transfusion time is prolonged.

The apparatus is very satisfactory whether used in the operating room or in

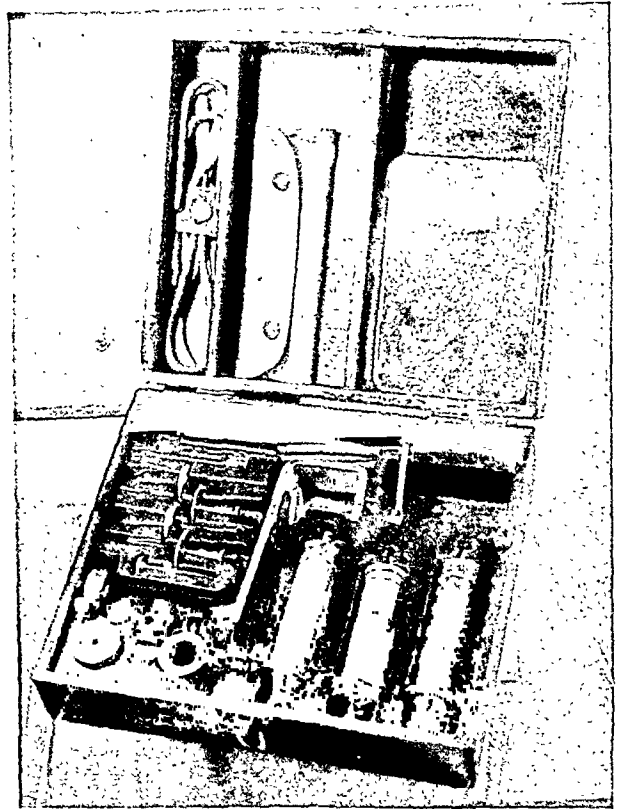


FIG. 2. Apparatus in case.

By the Brines method both syringes are used for withdrawing and injecting blood. A physician or nurse assistant is desirable but not essential to the complete success of the transfusion. A compact wooden case was constructed to house the complete outfit. In the upper half of the case there is ample space for instruments necessary for transfusion.



# CARGILE MEMBRANE IN PREVENTING INTRA-ABDOMINAL POSTOPERATIVE ADHESIONS\*

GEORGE S. FOSTER, M.D.

MANCHESTER, N. H.

POSTOPERATIVE adhesions are surely a curse to be avoided when possible. How many times we have seen cases of clean abdominal surgery that months after the operation returned complaining of that dull, dragging pain beneath the site of operation, marked constipation and a certain degree of disability.

A careful and thorough physical examination of these cases revealed no new pathology except the possibility of adhesions. Roentgenograms shows that the intestinal tract was bound down, kinked or twisted in certain areas adjacent to the field of operation. This in itself accounts for all of the signs and symptoms found and thus the diagnosis of postoperative adhesions is made.

Few, if any, of these cases reacted satisfactorily to any form of medication or non-surgical treatment. If observed over a long period they would remain about the same. Finally in some instances a secondary celiotomy was advised.

On the table these cases reveal in fact the conditions shown by the roentgenogram. This fact we have faced several times, some of the cases having been previously operated upon by ourselves and some coming from other hospitals. A careful study of these cases during the past ten years has brought into use in our clinic the introduction of Cargile membrane for use in these cases as a preventative of the reoccurrence of these adhesions following their release and the return of the intestines to their normal position and contour.

In the first few cases of its use we found that very satisfactory relief was obtained without the return of the signs and symptoms previously noticed. Carefully observing these first few cases over a period of

one to three years we were quite convinced that the use of Cargile membrane as a routine in covering over any intra-abdominal raw areas left after the operation was completed was satisfactory in preventing these postoperative adhesions.

Again we collected quite a number of cases that had been previously operated upon by ourselves or in other hospitals for an intra-abdominal purulent condition where longer or shorter drainage was necessary to save life. Of course, we would naturally expect these cases to yield multiple intra-abdominal adhesions and later on give the consequent signs and symptoms. In this class of cases we naturally found many more as well and more firm and completely organized adhesions which when released at the secondary celiotomy left many more or less extensive raw surfaces. In this class of cases we also introduced the Cargile membrane to cover over these raw surfaces and found that the results were very satisfactory. In observing this type of case over a period from one to three years we found that the relief to the patient of previous signs and symptoms was most gratifying.

Thus we have by gradual steps come to use Cargile membrane as a routine in all intra-abdominal surgery where even the smallest raw surface is left as a possible modus for the later attachment of the intestine to this surface. This routine we have had in action now for about five years and the cases that return to us with signs and symptoms of postoperative adhesions are very few. In fact, we have had no complaints. Our system now in vogue has as a part the follow-up report covering a period of two years. Thus we can check up fairly accurately.

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Of course, it is understood that in the cases which come to us with a purulent intra-abdominal condition cannot, at the

intestinal loops from adhering to a suture line in a gastroenterostomy or an entero-enterostomy.

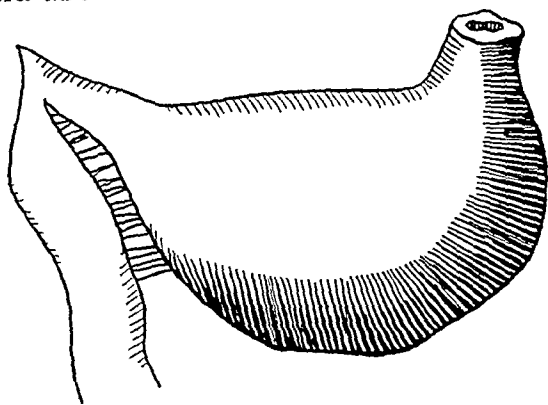


FIG. 1. Showing kink in duodenum secondary to adhesions.

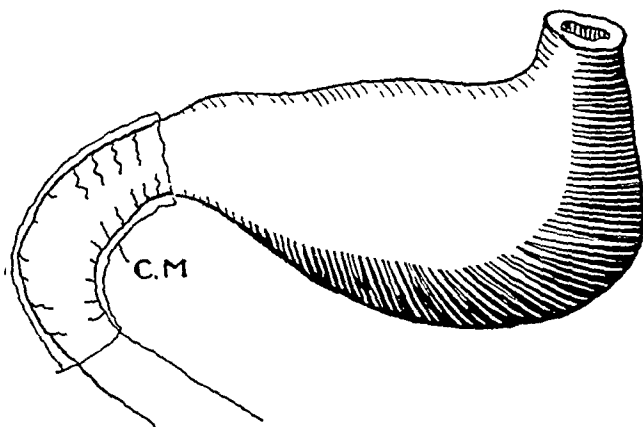


FIG. 2. Showing carginle membrane C. M. folded about raw area of duodenum.

first sitting, have the Cargile membrane used as it is directly contraindicated. As a matter of fact when used it very early dissolves by chemical, bacterial action and within a few days has disappeared. So, when it is used in these cases, does no good. In this class of cases we warn the patients, when discharged from the hospital, of the possibility of further trouble from postoperative adhesions and recommend that they return at the end of a two-year period for a complete observation and investigation to determine the presence or absence of any postoperative adhesions and the presence of any signs or symptoms as a result of such. If found present and giving any discomfort, we advise readmission for a secondary celiotomy and correction, using the Cargile membrane at this time. By following out this routine and instituting the relief operative measures we find that very satisfactory results are obtained.

In clean intra-abdominal cases such as hysterectomy, cholecystectomy, intestinal resection, strangulated or incarcerated hernias, gastroenterostomy and the like, we always use the Cargile membrane to cover all suture lines and raw surfaces. Thus are prevented coils of intestine from adhering to the raw points in the pelvic floor, the duodenum or pylorus from adhering to a suture gall bladder area, and other

Another type of case which is very apt to give a most tantalizing aftermath is found in that thick, heavy, pendulous, superfluous fat abdominal wall where because of its weight a constant pressure is exerted upon the abdominal wound closure suture line and the intestinal coils which are very apt to adhere to this closure line. Here the Cargile membrane plays a most important part when used to cover over the intra-abdominal contents just below the closure line of sutures. A double layer of Cargile membrane placed along this area will prevent any anterior wall adhesion of the intra-abdominal contents and give a most satisfactory outcome in these overweight cases.

At times one will find it quite impossible not to have raw areas of a more or less extensive nature even in those clean, intra-abdominal cases. Especially is this true where a very extensive resection of any part was to be accomplished in a very thin individual. Here we do not have any alternative as there is practically no fat to use for at least partially covering over these raw surfaces. Next to Cargile membrane and perhaps first in some instances, fat is our best friend and ally for this purpose. However we must always consider the fact that fat from any intra-abdominal region is already anatomically and normally basally attached to some

intra-abdominal organ or organs and thus, even if advantageously used, will always have the possibility of partial absorption and later contraction, producing that drag and weighty pain so frequently complained of in these postoperative adhesion cases. The use of Cargile membrane eliminates this possibility.

#### TECHNIC IN ITS USE

The application of sheets of Cargile membrane requires the adherence to certain fundamental principles. Two things are absolutely necessary: an operating-room instrument nurse who has been carefully trained in the handling of this membrane from its release from the envelope to the delivery to the operating field, and an assistant who fully cooperates and understands the instrumental handling of this membrane and its application as well as does the operator. These two fundamentals are absolutely essential for the successful application of the Cargile membrane in proper position with a guaranteed sterility. Every aseptic precaution must be executed to the last degree by the instrument nurse. There is one other thing: Cargile membrane should never be moistened the least particle prior to its application.

In handling Cargile membrane we have found that smooth tissue forceps with a very fine grasping bill serves best. The assistant with his forceps grasps one corner and the operator with his forceps grasps the direct-line opposite corner. The field is widely retracted and the contents fully exposed in proper positions. The grasped, taut edge is applied first and released, and the two direct-line opposite corners of the Cargile sheet are picked up in the forceps and the membrane sheet slowly bound over the raw surface or about the suture line. This is a very important point in its application and if cooperatively carried out will permit of a smooth, unwrinkled application of the membrane. The warm,

moist surface of the part to be covered will very greedily adhere to the membrane, thus covering it over and fully protecting it.

A great deal of patience is required in carrying out this technic which in itself is simple enough if these few rules are followed. At times, especially when a very freely movable wall comes adherent to the area covered, a second layer of this membrane placed directly over the first one will further enhance its usefulness.

Of course, it is understood that any surface must be very carefully sponged free of blood, blood clots or serum, prior to the application of Cargile membrane. Following its application all packed-off abdominal contents or retracted structures are very carefully released and permitted to very slowly and under guidance assume their normal positions. This part of the procedure requires very painstaking movements.

Once the Cargile membrane has been properly and smoothly coapted over the area or about this part, it is pretty apt to maintain its position quite firmly. The closure of the wound is then accomplished and dressed as usual.

One additional precaution, which it is fairly reasonable to observe in all cases, seems worthy of note especially in intestinal surgery: that is, splint the bowel with some form of hypodermic injection for the first twelve to twenty-four hours. By the first six hours the Cargile membrane has become quite a firm part of the surface upon which it has been placed and a little extra time allowed prevents any dislodgment by hyperperistalsis.

Cargile membrane therefore has a wide field of usefulness with a most satisfactory ending in so far as postoperative adhesions are concerned. For ourselves we have learned to believe in it greatly and we use it very extensively in this way, thus very largely eliminating those signs and symptoms previously seen as the result of postoperative adhesions.



# SCARLET FEVER

## FOLLOWING ABDOMINAL OPERATIONS\*

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CHICAGO, ILL.

SCARLET fever which follows an operation, a wound or a burn is spoken of as surgical scarlet fever. This condition is not uncommon and a large number of such cases have been reported in the literature. However, it is surprising how few are the case reports of surgical scarlet fever which follow abdominal operations.

The first description of a scarlatiniform eruption occurring after operation was recorded by Civiale<sup>1</sup> in 1858. In the same year Sée<sup>2</sup> reported a case where a generalized eruption resembling scarlet fever developed after an operation. However, neither of these authors believed he was dealing with scarlet fever. The credit for reporting the first case of surgical scarlet fever is generally given to Sir James Paget<sup>3</sup> who in 1864 gave a clinical lecture on surgical scarlet fever following operation. His first case occurred in a boy who had a stone removed from the bladder:

The boy, lately operated on for stone had scarlatina . . . Two days later it began to fade and in a few days had disappeared . . . All went on well for a month, the wound was nearly healed when he had severe pain in passing urine and evacuated with it a considerable quantity of blood from the kidneys . . . Two days after this, he had sore throat, then an eruption like scarlet fever again appeared. It continued for three days and was succeeded by desquamation. The urine in about ten days had gradually regained its natural condition . . .

If I had never seen a case similar to this, I should have hesitated to call it scarlatina; for the symptoms of the first attack were very incomplete and those of the second were unusual and disorderly. But I believe the case was really one of scarlatina modified by the circumstances in which it occurred . . .

About this time last year when scarlatina was very prevalent, I saw six cases after operations in private practice. I have notes

of four more that occurred either before or since and I have heard of many more. By some these cases may be supposed to have been only casual coincidences of scarlatina with surgical diseases; but, if they were so, we ought to find a proportionate number of cases among surgical patients not operated on. But this does not happen. In private practice, I do not remember to have seen scarlatina supervene in any surgical cases except those in which operations had been performed; and, in hospital practice, I doubt whether it is much more frequent among all the other patients taken together than it is in those who have been operated on. I cannot, therefore, doubt that there is something in the consequences of surgical operations which makes the patients peculiarly susceptible of the influence of the scarlatina poison. And, together with this susceptibility, we may observe that the disease undergoes in them certain modifications, especially in the period of incubation, which is much shortened. In all the ten cases I have noted, the eruption appeared within a week after the operation . . . Other deviations from the typical course of scarlatina were, that in some of the cases the eruption came out over the whole surface at once, and on the limbs more fully than on the face and chest; in some, there was no sore-throat; in others no desquamation.

The cases are not numerous enough to determine the import of these variable deviations from the type of scarlatina; but that in which all of them, whether complete or incomplete in other characters, agreed, namely, the very early period after the operation at which the rash appeared, deserves particular notice. It adds to the evidence, that the appearance of scarlatina is in some way connected with the early consequences of operations. If it were not so, and if patients after operations had only the same liability as others, there would be no reason why the eruption should appear early, rather than late, after the operation; but, as far as I have seen, it always appears early—always within the first week.

Two explanations may be offered of this

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fact. Either the condition induced in a patient by a surgical operation is one that gives a peculiar liability to the reception of an epidemic or contagious morbid poison, and any one of these, being imbibed immediately after the operation, produces its specific effect in much less than the usual period of incubation; or else those who suffer with scarlatina within a few days after operations had previously imbibed the poison, but would not have manifested its effects so soon, if at all, unless their health had been exhausted or disturbed. The second of these explanations appears rather the more probable; for it is in accordance with what has been observed when many persons have been exposed to the contagion of fever, and some have been afterwards exhausted by fatigue or otherwise. These have had fever; while those who rested after exposure have escaped it.

But, whatever explanation may be given, the fact of peculiar liability to scarlatina after operations seem certain, and may be important in relation both to the pathology of the disease and to the risks of surgery. In one of the cases which I have seen, it was fatal; in another, it was followed by fatal pyaemia; and I think it not improbable that, in some cases, deaths occurring with obscure symptoms, within two or three days after operations, have been due to the scarlet fever poison hindered, in some way, from its usual progress.

Immediately following the publication of Paget's lecture a number of cases of surgical scarlet fever were reported.

In 1881 at the International Medical Congress in London, Riedinger<sup>4</sup> and Marsh<sup>5</sup> read papers on surgical scarlet fever. In 1882 Batut<sup>6</sup> wrote a thesis on this subject and his belief was that there was no relationship between trauma and scarlet fever but that the association was simply a coincidence.

In 1887 Hoffa<sup>7</sup> wrote a critical review of the literature on surgical scarlet fever. He rejected most of the reported cases and accepted only those cases in which the eruption began in the wound. This author divided the eruptions which follow surgical operations into four types: (1) a vasomotor disturbance due to irritation

of the sensory nerves and evidenced by a transient urticaria or erythema; (2) a toxic erythema due to absorption of aseptic pyrogenous material from the traumatized area; (3) an infectious rash which occasionally occurs in septicemia or pyemia and is due to minute emboli composed of bacteria which lodge in the capillaries, and (4) true scarlet fever with the usual symptoms and complications, the microorganisms having entered by way of the wound and the eruption often beginning at the edges of the wound.

In 1902 de Bovis<sup>8</sup> exhaustively reviewed the literature and collected 150 cases but in his analysis he made use of only 100 cases because the others had insufficient clinical data. But even in the selection of these 100 cases, he was very liberal. He believed there were five points of difference between surgical and medical scarlet fever, as follows: In surgical scarlet fever a larger proportion of adults are attacked, there is slight or even absent angina, a short period of incubation, the eruption starts in or near the wound and desquamation occurs early or may be absent.

The last extensive review of the subject was made by Hamilton<sup>9</sup> in 1904. Her analysis covered 174 cases collected from the literature and to these she added 10 new cases. The whole subject was thoroughly discussed and the literature carefully analyzed in her paper. She stated that de Bovis' five points of divergence of surgical from medical scarlet fever are points in the diagnosis of erythema scarlatiniforme. The latter eruption when caused by toxemia or septicemia may come on a few hours after an operation of any kind or at any time in a long-continued suppurative disease. Hamilton points out that it is difficult to find two authorities who entirely agree on the cardinal symptoms which must be present to make a diagnosis of scarlet fever. The rapid onset of the symptoms, the early appearance of a characteristic rash, first on the chest and neck, then rapidly be-

coming general, the angina, the swelling of the lymphatic glands, the nephritis and the desquamation make up the typical picture of scarlet fever. But there are real cases of scarlet fever without fever, rash, angina, swelling of the glands, or nephritis. Desquamation, which is a late symptom, may be scanty or atypical, and even if it is characteristic it proves very little, because it follows other eruptive diseases also, such as erysipelas and erythema scarlatiniforme. Because of the great variability in the symptomatology of scarlet fever it may be difficult to differentiate scarlet fever from other diseases. The most common afflictions which give rise to confusion are sepsis and pyemia, erysipelas, the rash occasionally seen in diphtheria, especially in case of mixed infection with pus organisms, rashes due to poisoning by drugs and erythema scarlatiniforme. The latter disease is "a febrile affection occurring idiopathically or in association with septicemia, pyemia, autotoxemia, or drug or food poisoning, its most distinguishing features being the scarlatina-like eruption, the non-contagiousness and the tendency to recurrence."

According to Hamilton it seems justifiable to rule out as unproved all those cases in the literature of surgical scarlet fever in which the presence of toxemia or septicemia was highly probable and in which the symptoms deviated from those of typical scarlet fever but not from the symptoms of toxemia or septicemia. In the cases where the disease was undoubtedly scarlatina, Hamilton maintains "there is no convincing evidence that the relation between the wound and the scarlet fever was anything more than one of coincidence." "There is as yet no convincing proof in the literature that surgical scarlet fever is anything more than scarlet fever in the wounded."

In an article on Scarlet Fever in *Abt's "Pediatrics,"* Weaver<sup>10</sup> mentions that there were 27 cases of surgical scarlet fever among 2595 cases of scarlet fever in the Durand Hospital (Chicago). He

is of the opinion it has not definitely been shown that scarlet fever is more readily contracted by persons with wounds than others. The virus of scarlet fever may be introduced into the body through wounds and it would be proper to limit the term surgical scarlet fever to such cases. Weaver<sup>27</sup> believes that in some cases in which the infection enters through wounds, there seems to be quite a long period before general infection occurs and clinical scarlet fever develops.

#### REPORTED CASES FOLLOWING ABDOMINAL OPERATION

In spite of the extensive literature which has accumulated since Paget's first report in 1864 I have been able to collect from the literature only 32 cases of scarlet fever which followed abdominal operations. Certainly many more cases have occurred and have been recognized but they have not been reported. On the other hand, a few cases, as for example the first one listed below, cannot definitely be considered as cases of surgical scarlet fever because the clinical data are insufficient. They are, however, included because the authors may have had good reasons for reporting these cases as surgical scarlet fever. Brief abstracts of the cases described in the literature follow:

1. Paley and Goodhart,<sup>11</sup> 1879. A boy, aged four, was operated upon for a hernia on July 2, 1875. On July 25 his temperature rose to 101°F., he was drowsy, had a furred tongue, tonsillitis, swelling of the submaxillary glands and a uniform red rash on the legs. The wound looked clean and the child was much better on the twenty-seventh. There was no note concerning desquamation or albuminuria. Seven months later the child had an attack of measles.

2. P. Bollici,<sup>12</sup> 1890. On October 6, 1888 a bilateral salpingo-oophorectomy was performed. The patient had a normal temperature until the sixth day when high fever was noted and she had abdominal pain, headache, anorexia and burning sensation in the wound. However, the latter looked clean. An erythema was observed on the inner surface of the leg

and over the left lower quadrant of the abdomen. On the eighth day, the limbs and face were involved and blisters formed. The temperature decreased and by the sixth day after the appearance of the eruption, desquamation was progressing rapidly. It was found necessary to drain the lower angle of the wound.

3. Salomoni,<sup>13</sup> 1893. A Bassini operation was performed for left-sided inguinal hernia and on the morning following the operation an eruption was found around the incision. Later it was localized over the lower left quadrant of the abdomen and the upper part of the thigh. During the following days it spread. High temperature persisted for three days and there was oozing from the wound. Recovery was complete after eighteen days.

4. McGraw,<sup>14</sup> 1895. A boy, aged fifteen, who had had scarlet fever when he was eight years of age, was operated upon for gangrenous appendicitis with abscess formation. The appendix was removed and a rubber drain left in the abdomen. Five days after operation the patient had a chill and fever. The following day the temperature was 102°F., the throat was sore and there was a generalized scarlet rash. The tongue developed the regular strawberry appearance seen in scarlet fever. The boy vomited considerably but the abdomen was flat and free from tenderness. The wound was clean. Fever persisted until death. At autopsy the cause of death was found to be volvulus.

5. Moeller,<sup>15</sup> 1902. A nine-year-old girl was operated upon for bilateral inguinal hernia. Because the child was anemic, and had a persistent cough, each hernia was operated upon separately. The first operation was performed on October 21, 1901 and the wound healed by first intention. The second operation was done on November 6. On the evening of the third day following the latter operation, high fever was observed, the child was stuporous and her body was scarlet red. Tonsillitis was found the next day and a scarlatiniform eruption appeared on the chest. The tongue assumed the raspberry aspect characteristic of scarlet fever and the eruption spread all over the body. On the seventeenth day desquamation occurred. Both wounds remained clean but on one side the edges separated.

6. Martin,<sup>16</sup> 1903. A woman, aged thirty-eight, who had had scarlet fever at the age of fourteen, had an appendectomy performed

on April 3, 1901. On April 5 the pharynx, mouth, tonsils and tongue showed a raspberry color, the patient had frequent fits of coughing and she had high fever. An exanthem appeared first on the neck and soon covered the entire body. On April 8, pus was obtained from the wound and on the tenth desquamation commenced. A large amount of albumin was found in the urine. By April 20 the desquamation was complete. The wound was not entirely healed until two months after operation.

7. Gerasimovich,<sup>17</sup> 1903. On a six-year-old child an operation for right inguinal hernia was performed on February 23, 1902. The next day fever developed and this increased gradually. On the twenty-sixth, the wound was found to be reddened, infiltrated and slightly purulent and on the twenty-seventh a pale pink eruption appeared. The pharynx was hyperemic and the tongue furred. On March 1 the characteristic tongue of scarlet fever was observed and the pharynx was red. The patient was transferred to the scarlet fever ward. Desquamation began March 9 and on the fifteenth there was an inflammation of the middle ear which subsequently cleared up. Staphylococci were recovered from the blisters around the wound, streptococci from the pus in the wound and diplococci and streptococci from the pharynx.

8. Gerasimovich, 1903. A child, aged one year and eight months, was operated upon for inguinal hernia on April 25, 1902. Fever developed four days after operation and a pale pink scarlet fever eruption appeared on the body. On May 1 the wound was found to be suppurating. The following day the characteristic tongue of scarlet fever was noted and there was high fever. The patient was transferred to the scarlet fever ward. On May 9 desquamation commenced. The wound closed after having drained a long time. Diplococci and streptococci were recovered from the pharynx and saprophytic bacteria from the wound.

9. Nicolotti,<sup>18</sup> 1904. A herniotomy was performed on a boy nine years old and on the following morning there was slight fever, tachycardia, a coated tongue and a reddened throat. The next day an eruption was seen all over the lower part of the abdomen and around the wound. The eruption spread to the thorax and back. On the sixth day desquamation began. The wound healed per primam.

10. Bernard,<sup>19</sup> 1906. An operation for the cure of an inguinal hernia was performed

on a six-year-old child. The herniated mass consisted only of the appendix which was adherent to the sac of the hernia. One week after operation the patient developed high fever and a pronounced case of scarlet fever manifested itself. The wound was probed and thick pus escaped under pressure. It was ascertained that there were a number of cases of scarlet fever at the school which this child attended.

11. Davidovitsch,<sup>20</sup> 1908. On September 25, 1894 a twenty-six-year-old woman had a ventrofixation of the uterus. On September 28 there was fever and dysphagia. Eight days after operation the wound was found to be slightly infected. The skin was red, the tongue presented the characteristic appearance seen in scarlet fever and there was slight conjunctivitis. Desquamation took place and the patient left the hospital October 2.

12. Davidovitsch,<sup>20</sup> 1908. A thirty-year-old patient was operated upon for bilateral hernia on February 18, 1902. Two days later a scarlatinal rash was observed over the entire body. The wound healed by primary intention. Desquamation occurred and on May 6 the patient left the hospital.

13. Davidovitsch,<sup>20</sup> 1908. A woman, aged forty-five, had a ventrofixation performed the latter part of February, 1902. Shortly after operation there was high fever, dysphagia and a diffuse scarlatinal rash all over the body. The tongue and throat were coated. The urine contained albumin from March 15 to 31. The patient was discharged May 20.

14. Davidovitsch,<sup>20</sup> 1908. A patient, aged twenty years, was operated upon for appendicitis April 10, 1905. On April 15 she had severe pain in the throat, headache and a rash over the entire body. The face was dark red, the right tonsil swollen and coated and the cervical glands swollen. Desquamation occurred and the patient was discharged June 13.

15. Davidovitsch,<sup>20</sup> 1908. A woman, aged thirty-six, had an Alexander-Adams operation on July 8, 1905. On the eighth postoperative day there was fever, difficulty in swallowing and a scarlatinal erythema over the entire body. The face and cheeks were very red; the tongue was reddened at the edges and the papillae were raised. The throat was red and swollen but not coated. There was albumin in the urine for five days. Desquamation occurred in large pieces. The wound healed normally and the patient was discharged August 28.

16. Davidovitsch,<sup>20</sup> 1908. A forty-three-year-old woman had an anterior and posterior colporrhaphy and an Alexander-Adams operation on July 15, 1905. On July 20 fever and a scarlatinal rash over the entire body were noted. The face and tongue were red, and the throat was likewise red and swollen but not coated. There was slight suppuration of the wound. Desquamation occurred and the patient was discharged on August 25.

17. Davidovitsch,<sup>20</sup> 1908. On September 25, 1905, a laparotomy was performed for myomata of the uterus. Three days later there was an elevation of temperature and on the seventh day a scarlatinal exanthem was observed on the chest. The tongue was coated, the tonsils were normal, and there were no glandular swellings. The wound was found to be infected. The fever lasted five days. Desquamation occurred and the patient left the hospital on November 16.

18. Davidovitsch,<sup>20</sup> 1908. A girl, aged sixteen years, was admitted to the hospital March 27, 1906. She had had two operations for hematosalpinx, the first three weeks before admission, and the second two weeks later. Immediately after the latter operation, there was high fever, difficulty in swallowing and a scarlatinal rash. The tongue and throat were fiery red and there was albumin in the urine. Desquamation occurred and the patient was discharged on May 14.

19. Davidovitsch,<sup>20</sup> 1908. A girl, aged eleven years, had a herniotomy on April 8, 1907. Four days later fever and a rash were present and the patient complained of a sore throat and headache. The tonsils were enlarged and red, and the submaxillary glands were swollen. Desquamation took place. The wound healed per primam and the patient left the hospital May 10.

20. Roberts,<sup>21</sup> 1915. A twenty-seven-year-old woman had her appendix removed and made an uneventful recovery until the ninth day postoperative when there was a rise in temperature and a sore throat developed. Two days later an eruption appeared over the neck, chest, arms and back. A diagnosis of scarlet fever was made and the patient was sent to the scarlet fever pavilion of a contagious hospital. She made a complete recovery.

21. Port,<sup>22</sup> 1922. A boy aged two and one-half years was admitted to the hospital on July 30, 1918. Eight days previously he had been operated upon for an inguinal hernia.

At the time of admission the temperature was 104°F. and there was a typical scarlet fever exanthem over the entire body. On August 14 there was extensive desquamation. On August 25 the child, although still desquamating, was discharged upon request of the parents. The wound healed by first intention.

22. Port, 1922.<sup>22</sup> A twenty-seven-year-old man had an appendectomy September 27, 1927. On October 3, he developed high fever and headache. The next day there was pronounced redness on the neck, limbs and face, and on the following day angina developed. A glass drain was inserted into the wound. On October 16 there was extensive desquamation. By October 25 the wound was closed but desquamation continued until November 12.

23. Port, 1922.<sup>22</sup> From a patient, aged nineteen years, the appendix and an ovarian cyst were removed on April 16, 1917. The next day she developed signs and symptoms of scarlet fever and was transferred to the contagious ward. On April 20 the scarlatiniform rash extended all over the body. On May 15 there was extensive desquamation. The patient was discharged on June 2 after the wound had been completely closed for one week.

24. Port,<sup>22</sup> 1922. A two-year-old girl was operated upon for a hernia February 14, 1917. The following day she developed fever and a light red exanthem on the neck and limbs. The throat was red. On February 28 the wound was found to contain pus. On March 11 there was desquamation. The patient was discharged April 4.

25. Günther,<sup>23</sup> 1924. A fifteen-year-old boy was operated upon for appendicitis and diffuse peritonitis. Drainage was instituted. Four days after operation there was high fever and nausea. The following day a scarlet fever eruption appeared on both flanks and soon spread over the entire body. Angina also appeared and desquamation began fourteen days after operation. The wound healed rapidly.

26. Floris,<sup>24</sup> 1927. A woman, aged thirty-two years, had a subtotal hysterectomy and bilateral salpingo-oophorectomy for suppurating fibroids. The operation was performed under lumbar anesthesia on September 11, 1926. On the fourth day after operation a red eruption, scarlatiniform in character, appeared on the neck, thorax and back. There was pyrexia and tachycardia and the throat was reddened.

Signs of hyperthyroidism were evident. The following day, the eruption became generalized. Desquamation followed but the signs of hyperthyroidism persisted. The patient left the hospital on October 25, but returned the following January with symptoms of malignancy in the lungs. She died February 1. Subsequent careful examination of the fibroids removed at the operation revealed sarcomatous degeneration.

27. Rivaroli,<sup>25</sup> 1927. A man was operated upon October 1, 1926 for suppurating hydated cyst of the liver. He developed scarlet fever on the third day after operation.

28. Rivaroli,<sup>25</sup> 1927. Another patient was operated upon for a hydated cyst of the liver on December 31, 1926. Symptoms of scarlet fever appeared on January 3, 1927.

29. Rivaroli,<sup>25</sup> 1927. A male patient was operated upon for an ectopic testicle on June 10 and he developed scarlet fever on June 14.

30. Rivaroli,<sup>25</sup> 1927. A patient had an appendectomy on July 6, 1926, and began to show signs of scarlet fever on July 8.

31. Rivaroli,<sup>23</sup> 1927. A young girl had her appendix removed and two days later a scarlatiniform eruption appeared accompanied by fever. Desquamation occurred shortly afterward.

32. Winter,<sup>26</sup> 1929. This case was mentioned in an article which Winter wrote on cesarean section based upon information received by means of questionnaires. I am indebted to Professor Stoeckel whose patient this was for the history of the case. A primipara, aged twenty-six, was delivered by means of a cesarean section on February 28, 1928, because of toxemia and abruptio placentae. On March 2, there was fever and a sore throat. Cultures from the throat showed hemolytic streptococci. There was marked edema and eruption all over the body, circumoral pallor and a raspberry tongue. The wound was clean. A diagnosis of scarlet fever was made and the patient transferred to the isolation pavilion where the diagnosis was confirmed. Scarlet fever serum was given and this was followed by typical eclamptic convulsions. The rash became more pronounced and after more convulsions the patient collapsed and died. Autopsy revealed exudative peritonitis in the presence of a well-healed operative wound, fatty degeneration of the kidneys with multiple hemorrhages, fatty degeneration of the liver with hemorrhages and a soft spleen.

## UNREPORTED CASES

To these 32 cases reported in the literature, some of which probably were not true cases of scarlet fever, I should like to add the following case reports. The first case is the only one I have personally encountered.

CASE I. Miss P. P., No. 1,071,474, age twenty-two, was admitted to the Cook County Hospital on July 11, 1928 complaining of pain in the lower abdomen and leucorrhea which had been present for three years. The pain had begun suddenly three years before admission and had recurred periodically about every four weeks. The attacks which were severe usually lasted about seven to ten days and subsided after rest in bed and ice bags placed on the lower abdomen. During this time a profuse leucorrheal discharge was present and dysmenorrhea also was a prominent symptom. The last menstrual period had begun July 6, 1928 and, for the first time, the flow was excessive and lasted nine days.

The patient had had a number of childhood diseases but she was not certain she had had scarlet fever. Her tonsils had been removed four years before admission. The menses began at twelve years of age, recurred every twenty-five days and generally lasted three days without pain until the present illness began. The general physical examination revealed no abnormalities. There was definite tenderness in both iliac fossae and slight rigidity in both lower quadrants but no masses were felt. Vaginal examination revealed the following: There was a nulliparous outlet, a long, hard and irregular cervix and a corpus uteri of normal size, hard, anteflexed and movable. In both fornices were tender, cystic and adherent masses. The one on the left was about 7 cm. in diameter and the one on the right was much smaller. The diagnosis was pelvic inflammatory disease with a tubo-ovarian abscess on the left side.

An operation was performed on July 20 and I removed a tubo-ovarian abscess from the left side and a pyosalpinx from the right. The patient did well the day of the operation and the following day.

On the third day the temperature rose to 101°F. but the patient insisted she felt well. On the fourth day there developed a generalized, red, maculopapular eruption with an

underlying erythema. The rash was most prominent on the flexor surfaces of the extremities. The tongue was red, glossy and strawberry-like. A diagnosis of scarlet fever was made and the patient was transferred to the Contagious Disease Hospital. At the latter hospital, examination showed that the maculopapular rash involved the axillae, the breasts and the flexor surfaces of the extremities with definite linear markings in the cubital regions of the arms. There was a slight eruption over the upper abdomen and back, but none on the face and neck. The tongue was strawberry and almost raspberry in appearance. The papillae were enlarged, hence the disease was in about the fourth-day stage, but the rash had the appearance of an earlier stage. There was slight congestion of the pharynx. A diagnosis of surgical scarlet fever was made. Two days after admission to the Contagious Disease Hospital the rash was fading rapidly but the tongue was still typical of scarlet fever. The skin sutures were removed July 28 and a small abscess was found in the region of the lowest stitch. Otherwise the wound had healed perfectly. On July 31, there was desquamation on the face, neck, abdomen and extremities. Following this, the convalescence was fairly good and the patient left the hospital on August 15.

CASE II. (I am indebted to Dr. K. Speed for the following case report.) L. A., No. 1055-884, aged six, was admitted to the Cook County Hospital, March 27, 1928 because of a swelling in the left half of the scrotum. The past history was negative and the general examination revealed no abnormalities. In the left half of the scrotum was a swelling which was soft and the size of a walnut. The swelling was reducible and gave a distinct impulse on coughing. The point of reduction lay medial to but was separate from the internal abdominal ring. A diagnosis of left direct inguinal hernia was made and on April 4, Dr. K. Speed operated on the boy. On the third day following operation the temperature rose to 103°F. and there was much tenderness and induration around the herniotomy wound. The next day the temperature was the same, the pulse was 128 and the respirations 28 per minute. A punctate erythematous rash was noticed, involving the back of the neck, arms and chest. No Koplik spots were present and the tongue appeared normal. The throat

was negative and the wound looked clean. The white blood count was 29,200. On April 9, the temperature was 101°F., the tongue showed prominent papillae and the throat was moderately congested. The wound was infected and when opened permitted a bloody purulent discharge to escape.

The patient was transferred to the Contagious Disease Hospital with a diagnosis of scarlet fever. At the latter hospital examination showed a punctate erythema over the entire body and extremities. The face was slightly red and there was circumoral pallor. The rash disappeared on pressure. The throat was reddened but the tongue was not involved. A definite diagnosis of scarlet fever was not made until the following day. On April 17 desquamation was taking place, especially on the hands and feet. On May 4, quarantine was lifted and on May 6 the boy was transferred to the children's surgery ward where the infected wound was treated. The boy was discharged on May 25 at which time the wound had practically healed entirely.

CASE III. (I am indebted to Dr. A. L. Hoyne for the following two case reports.) R. F., No. 1120560, aged eighteen, was admitted to the Cook County Hospital on June 10, 1929 because of severe pain in the right lower quadrant and vomiting. The temperature was 99.4°F., and the pulse 104 per minute. The white blood count was 18,000 and the urine negative. There was tenderness and rigidity in the right lower quadrant and a diagnosis of subacute appendicitis was made. The condition subsided and the patient was operated upon on June 22 by Dr. Johnson. The pathological diagnosis was subacute appendicitis. On the evening of the second day the temperature rose to 103°F., and the pulse was 114 per minute. The pharynx was injected. The next day the temperature was the same, the pulse rose to 140 and the pharynx remained injected. The wound was in good condition. A diagnosis of acute pharyngitis was made but the patient was isolated because there was a suspicion the condition might be scarlet fever. The patient's mother said the patient had had scarlet fever in childhood. On the evening of the third day after operation, the temperature rose to 105°F., The next day Dr. Hoyne saw the patient and made a diagnosis of scarlet fever. The patient was transferred to the Contagious Disease Hospital immedi-

ately. At this time a strawberry tongue was present. Early the following morning symptoms of collapse appeared and the patient died shortly afterwards. An autopsy was not obtained.

CASE IV. L. H., a white woman eighteen years of age, was admitted to the Municipal Contagious Disease Hospital with a typical attack of scarlet fever on June 24, 1929. She had been operated upon for pyosalpinx on June 14 and developed scarlet fever six days later. On admission pus was being discharged from the abdominal incision. The patient had multiple arthritis of a mild degree as a complication of her scarlet fever. She made a complete recovery and was discharged on August 1.

In addition to these unreported cases I have received from Dr. George H. Weaver the following 4 brief case reports of scarlet fever following abdominal operation. These cases were observed at the Durand Hospital during a period of fifteen years from 1913 to 1927 and occurred among 3,979 cases of scarlet fever. During the same period there were 52 cases of surgical scarlet fever in the hospital, but only the 4 described below followed abdominal operations:

CASE V. A child, No. 2623, aged five, had an operation for appendicitis on January 1, 1918. The abdominal wound suppurated and beginning January 20, typical scarlet fever developed.

CASE VI. Patient No. 4241, aged nineteen had a bilateral salpingectomy performed about one month before admission on March 15, 1920. On entrance to the hospital the wound was open and suppurating. From the pus in the wound numerous hemolyzing streptococci were cultured and typical scarlet fever was present. The scarlet fever began about three weeks after the operation.

CASE VII. Patient No. 6739, aged thirty-six, had her fallopian tubes removed March 14, 1923. On March 18 she had chills, fever and a sore throat. On March 21, a scarlet fever eruption appeared and the wound was slightly infected.

CASE VIII. Patient No. 9321, aged six, had a herniotomy performed on April 16, 1926. On April 20 typical scarlet fever developed and



hemolyzing streptococci were cultured from the infected wound.

#### SUMMARY

The literature on surgical scarlet fever was reviewed and all the cases following abdominal operation were abstracted. To the 32 cases reported I have added 8 unreported cases, all of which occurred in Chicago. Many other cases have certainly been encountered, not only in Chicago

but elsewhere, but they have not been reported in the literature. Surgical scarlet fever does not differ from the non-surgical type and the symptomatology and treatment are identical. It may not be amiss to emphasize that surgeons who attend cases of scarlet fever should be especially careful in their asepsis when operating. During epidemics of scarlet fever, only those operations should be performed which are absolutely imperative.

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# IMMEDIATE CAUSES OF DEATH FOLLOWING OPERATIONS ON GALL BLADDER & DUCTS\*

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THE study which forms the basis of this thesis was first suggested to the writer when at a staff surgical conference which he attended the question was asked, "What are the chief causes of death following gall bladder operations?" From the discussion which followed it was quite evident that among the several surgeons present no one had any really satisfactory knowledge of the subject. A subsequent review of the literature revealed the fact that notwithstanding the rather abundant literature dealing with the mortality rates associated with gall bladder surgery, there is a decided paucity of systematized data concerning the relative frequency of the various causes immediately responsible for the mortality following operations on the biliary tract. In order to get the desired information on this subject, the writer has collected from the literature the causes of death as given in 400 fatal cases. Also, in addition to the above, and for the purpose of more detailed comparative studies, he has reviewed the hospital charts and other available data pertaining to 100 postoperative gall bladder deaths collected from his own case histories, from the records of the Ellis Hospital and from the records of fatal cases furnished by a number of his surgeon friends.

Table 1 gives a summary of the causes of death as collected from the literature and from the personally studied case histories, the combined figures comprising a total of 500 fatal cases.

The term, cause of death, to a large extent represents a clinical opinion and even with most detailed data including autopsy findings opinions may differ in the individual case as to the actual cause of death. Nevertheless, when a fairly

TABLE I  
SUMMARY OF DEATHS COLLECTED FROM LITERATURE  
AND FROM HOSPITAL RECORDS

	Lit.	Hosp. Records	Total
Operative shock	25		25
Operative hemorrhage	23	9	32
Pulmonary embolus	31	2	33
Fat embolism	1	2	3
High temperature rapid deaths	5	15	20
Acute gastric dilatation; pyloric obstruction	3		3
Intestinal obstruction	6		6
Protracted vomiting	1	4	5
Rupture of incision.	1		1
Anaesthetic death $N_2O_2 + O_2$		1	1
Duodenal perforation; operative trauma		1	1
Serum anaphylaxis		1	1
Erysipelas abdominal wound	1		1
Peritonitis; bile not mentioned	73	4	77
Spontaneous perforation gall bladder or ducts; bile peritonitis	24	8	32
Subdiaphragmatic abscess	6	1	7
Cholemia; no hemorrhage	13	9	22
Cholemia; postoperative hemorrhage	10	10	20
Hepatic insufficiency	19		19
Cholangitis and liver abscess	19		19
Overlooked duct stones	2		2
Sepsis (pyemic processes)	16		16
Acute pancreatitis	5	2	7
Cirrhosis of liver	3	2	5
Acute infection; fulminating acute cases	2		2
Pancreatic asthenia		1	1
Exhaustion	4		4
Pneumonia and pulmonary deaths	47	6	53
Cardiac failure; myocardial conditions	30	4	34
Renal failure	18	6	24
Diabetic coma	1		1
Thyroid intoxication	1		1
Thrombosis iliacs and vena cava	1		1
Complications of other operations	1	3	4
Cerebral hemorrhage	1	1	2
Acute hepatitis; alcoholism		1	1
Delirium tremens, mental conditions		2	2
Undetermined	7	5	12

large series of cases is studied, it is found that a considerable proportion of the

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individual cases falls into sharply defined groups which can be determined with far more certainty than the detached individual case. I believe that the series here reported does give a reasonably accurate picture of the causes of death encountered by a number of surgeons in the course of approximately 10,000 gall bladder operations.

The hazards of gall bladder surgery naturally fall into several more or less sharply defined categories, as for instance, the dangers incident to the operation itself, the dangers due primarily to the disease process itself and the dangers more or less associated with the age and general condition of the patients who suffer from gall bladder disease.

Operative shock and hemorrhage account for a total of 57 deaths, or 11 per cent of all of the operative fatalities. From the literature data, it would seem that operative shock and hemorrhage are about equally responsible, there being 25 cases classed as shock and 23 as hemorrhage. However, most of the 9 cases from the personally studied charts now listed under hemorrhage were charted as deaths due to shock. In studying the operation reports and charts of these 9 cases, it is perfectly clear that hemorrhage was the primary cause for nearly all of these immediate operative disasters. A clamp or ligature slipped, or a vessel was torn, and then the trouble began. These operative hemorrhage deaths represent 9 per cent of the total mortality of my series and the shock and hemorrhage cases account for 11 per cent of the deaths collected from the literature and yet, they represent only a fraction of 1 per cent of the total cases operated. The problem of the control of hemorrhage during operation is a purely technical one. Careful, accurate technic with the application of sound judgment in the presence of difficulties can certainly reduce the incidence of hemorrhage and shock to a point where it does not represent anything like  $\frac{1}{10}$  of the total hazard of gall bladder operations.

Pulmonary embolus accounts for 33 deaths, or 6.6 per cent of the total. In the writer's series only 2 per cent of the deaths were ascribed to pulmonary embolism, whereas in the group collected from the literature nearly 8 per cent are listed as due to this cause. When going over the literature, I was inclined to feel that some of the surgeons reporting cases were perhaps partial to pulmonary embolus as a cause of death. It seems probable that the 6.6 per cent as represented by the combined figures may represent approximately the truth. Wilson<sup>1</sup> records only 9 deaths from pulmonary embolism in 4597 operations on the gall bladder.

Only 3 deaths are listed as due to fat embolism. The writer is, however, inclined to believe that fat embolism may have been a contributing cause of some of the deaths listed under other causes.

Along with the other causes of death associated directly with the operation itself, 20 deaths are listed under the term, "high temperature rapid deaths." In the writer's series collected directly from the clinical records, this is the most frequent terminal picture encountered. In this series, it is represented by a rather sharply defined group of 15 cases which can be assigned to no other cause or causes. It seems probable that at least 3 or 4 other deaths occurring in this personally studied series could properly be placed in this group but, because in the recorded histories other causes have been definitely assigned by the attending surgeons, they have not been listed as high temperature rapid deaths.

The charts of the 15 cases included in this group present a striking and, I believe, a sharply defined picture. They are characterized chiefly by a rapid, steady rise in temperature. Before death, temperature readings of 105° to 106° or even higher are not uncommon. The temperature rise usually begins within six to twelve hours after the operation. With the temperature once started on its upward trend, there

<sup>1</sup> WILSON. Fatal postoperative embolism. *Ann. Surg.*, 56:811, 1912.

are seldom any remissions and death usually ensues within thirty-six to forty-eight hours. Along with the rapid and extreme rise in temperature these patients present a greatly accelerated, weak pulse, extreme nervousness and, toward the last, rapid shallow respirations. Charts Nos. I to VI show the character of the temperature, pulse and respiration curves encountered in these cases. One other point of interest in connection with these cases is the fact that in not one of the 15 deaths had the surgeon in attendance ventured an opinion as to the cause of death.

The writer knows of no other terminal picture occurring in surgical cases which very closely simulates these high temperature rapid deaths. While individual cases occurring once or twice in several years' work might escape notice, the combined group stands out in a manner which suggests that this type of death may be as closely associated with biliary surgery as is postoperative hyperthyroidism with goiter surgery.

During the past few months, I have discussed the problem of these cases with possibly 25 surgeons, every one of whom can remember similar tragedies in his own practice. No one of them, however, has had any satisfactory explanation to offer as to the cause. Among those who have given special study to gall bladder surgery or who have done experimental work on the gall bladder and liver, no two have agreed on the possible explanations they have suggested. One says, "we believe these particular patients died from absorption of either diseased or chemically altered liver cells or toxic bile." Another experimental investigator suggests that altered cholesterol metabolism may be responsible while still another suggests that injury to the nervous mechanism of the liver may be responsible for these fatalities.

In the literature I have been able to find only one undoubted reference to this type of death. Cave<sup>2</sup> in 1926 in reporting

35 postoperative gall bladder deaths from the Second Surgical Division, Roosevelt Hospital, under the head of "Immediate Operative Mortality of Unknown Origin" reports 3 of these cases as follows:

There were three cases that died within forty hours with immediate hyperpyrexia one 107.2 degrees, another 106 degrees and the other 107 degrees; hemorrhage, peritonitis, pneumonia, embolism were all ruled out clinically; in all cholecystectomy was the procedure. These were not the acutely inflamed type but simply cases with symptoms of prolonged chronic cholecystitis with calculi in the gall bladder in otherwise healthy women, not jaundiced. In one, a cholecystostomy had been done one year previously. According to the operative notes the procedures were carried through without difficulty, in fact, two noted as being extremely easy. All three were drained, one through the upper angle of the wound, the other through lateral stab wounds with tight closure of the anterior abdominal wound. It seemed that immediately the operation was finished, the temperature began to rise and reached exceedingly high levels with an accompanying rapid pulse rate. Although no mention is made of unusual liver traumatization except in one instance, we believe these particular cases died from absorption of either diseased or chemically altered liver cells or toxic bile. The appearance or consistency of the liver was not noted.

It is a startling and helpless situation to follow to its quick termination one of these catastrophies—the last one of these three here reported occurred in a young healthy vigorous Greek woman of thirty-five with a definite and classical history of diseased gall bladder for a period of over three years without jaundice; heart, lungs, kidneys normal; cholecystography revealed numerous shadows indicative of stones in a slightly enlarged gall bladder. Operation upper right rectus incision and easy and splendid exposure of gall bladder and ducts; the cystic artery and duct fully exposed; comfortably handled and twice transfixed with chronic catgut before being cut across and the third ligation of the duct and artery made by transfixion and tying after removal of the clamp and the gray-walled, stone-filled gall bladder; the excision being easily carried out from below upward. The liver bed from which it was removed was rather broad, however, with only

<sup>2</sup> CAVE, H. W. Dangers incident to cholecystectomy. *Ann. Surg.*, 84: 371-378, 1926.

moderate oozing; the sulcus sutured over with the stump of the cystic artery and duct securely tucked and sutured into it at its lowermost angle, so dry was the area that it was remarked to be an ideal case for closure without drainage, however, a lateral stab wound to flank, wrapped tube drain to Morrison's pouch and a tight closure of the anterior abdominal wound was done. Immediate precipitous rise of temperature to 106 degrees at the termination which took place in forty hours. Pulse rate rose steadily with temperature curve to 154, no signs of pneumonia clinically or from portable x-ray films, a dressing done the drain loosened and withdrawn a short distance, a slight amount of bile-stained secretion on the dressing. No evidence whatever of hemorrhage.

I have also found two other individual cases reported in the literature. The typical clinical picture is described in each instance without to diagnose the cause of death.

The clinical picture is almost certainly that of an overwhelming toxemia. Because in one of my early cases I found at autopsy a definite acute cholangitis extensively involving the intrahepatic bile ducts, and because within the scope of my observations several of these deaths had occurred following operations performed during or just following acute attacks, I had until quite recently felt reasonably certain that these deaths were due to acute cholangitis. The very direct relationship of the onset of the hyperpyrexia to the operation, I had postulated as being in some way due to the lighting up of an infection as a result of operative manipulations or interference with liver functions. More recently a number of facts have been observed which do not square with the cholangitis hypothesis. In the first place, microscopical examination of the liver as found at autopsy does not always show the expected degree of cholangitis. Also, I have among my charts a recent case of a young man, age twenty-three, who died forty-seven hours after a traumatic rupture of his liver. Hemorrhage from a 2 in. rent in the dome of his liver was the predominating intra-abdominal finding, both at opera-

tion six hours after the injury and at autopsy. Most certainly this young man did not have a cholangitis. Had the same amount of intra-abdominal hemorrhage been the result of an ectopic pregnancy or a ruptured spleen, the clinical picture would have been that of the shock due to the hemorrhage, namely, a rapid pulse with a subnormal or but slightly elevated temperature. In this case of ruptured liver, the temperature began to rise soon after admission and reached 105.6° twenty-two hours after the accident. The clinical picture presented by this traumatic liver death is so strikingly similar to that seen in the high temperature, rapid deaths following gall bladder operations that I am led to suspect very strongly that similar factors are operative in each instance.

What these factors are I am unable to state at the present time. In many respects the high temperature, rapid pulse clinical picture is not totally unlike postoperative hyperthyroidism. Crile has shown a close interrelationship between the thyroid, the adrenals and the liver. The complex relations of the liver to states of shock and to basal metabolism have been studied by many investigators. Nowhere in the literature that I have so far studied, have I come across any data tending to throw much light on the problem presented by the 15 high temperature, rapid deaths found in this series.

It is possible that the blood chemistry observable during the period between operation and death might throw some light on the nature of the condition. We intend making these studies the first time we are unfortunate enough to encounter one of these cases again. The ideal way would be for surgeons interested in the problem to report their findings to a central clearing house for correlation and analysis.

In the series collected from the literature, 3 deaths are listed as due to acute gastric dilatation or pyloric obstruction and 6 deaths as due to intestinal obstruction.

A total of 5 deaths are listed as due to protracted vomiting. Four of these cases

occurred in the series studied by the writer. These 4 deaths presented no other particularly noteworthy features in the terminal picture. The vomiting was of the frequent gulping type not uncommonly encountered after gall bladder operations. Persistent vomiting of this type has long been recognized as one of the common and occasionally dangerous complications following gall bladder operations. In some cases gastric lavage has seemed to give marked relief and if so the condition may be accounted for as being the nature of a temporary pyloric obstruction. Other cases are apparently not influenced by lavage or other therapeutic means. The writer has never been able to account satisfactorily for these cases. It is quite possible, however, that the experimental work of Horrall and others may throw some light on this subject. When bile is injected into the peritoneal cavity of a dog or when it is allowed to flow into the peritoneum through an opening in the gall bladder, persistent vomiting is one of the most constant symptoms of the bile poisoning. In the light of this experimental data, it seems quite possible that absorption of bile either from the free peritoneum or from surfaces in contact with bile-soaked drainage gauze may be the cause of this type of vomiting. When the writer read the reports of Horrall's experiments he resolved that in the future he would be much more careful not only as regards spilling of bile at the time of operation but also as regards the use of drains which might become bile-soaked and serve as reservoirs from which the bile could be absorbed. This whole subject warrants careful clinical study to examine the facts from the viewpoints suggested by the experimental findings.

Among the less common causes of death directly associated with the operation itself, rupture of the incision, anesthesia  $N_2O_2 + O_2$ , operative injury of the duodenum, serum anaphylaxis following prophylactic injection of rabbit serum to control bleeding and erysipelas of the

abdominal wound account for one death each.

The cases of erysipelas of the abdominal wound is the only instance in the entire series studied in which a surgical infection of the accidental type is given as a cause of death.

In the combined series, peritonitis is credited as the cause of 109 deaths. Thirty-two of these deaths were definitely due to bile peritonitis leaving 77 deaths or 15.4 per cent of the total listed simply as peritonitis. In the writer's series only 4 per cent of the deaths are ascribed to peritonitis other than bile peritonitis while in the cases collected from the literature over 18 per cent of the fatalities are listed simply as due to peritonitis. It seems probable that a considerable proportion of the 73 deaths recorded in the literature as due to peritonitis was due primarily to leakage of bile rather than to intraperitoneal infection. It is only within the last few years that the importance of bile peritonitis distinct from peritonitis of purely infectious origin has been recognized. The peritonitis cases reported in the literature were to a considerable extent grouped in relation to certain types of operative conditions. First, peritonitis as might be expected is frequently associated with operations performed during the acute stage in the severe, fulminating types of cases. Also, it is a frequent cause of death after the more difficult common duct operations and particularly after secondary operations on the ducts. Peritonitis is apparently the chief cause of the deaths occurring in cases in which fistulae between the gall bladder and stomach or intestines are found at operation. Several of the peritonitis deaths followed accidental operative injury of some portion of the intestinal tract.

Thirty-two deaths in the combined series occurred in the presence of spontaneous perforation of the gall bladder or ducts. This condition is considered a relatively rare complication of gall bladder disease but when it does occur it is associ-

ated with a very high operative mortality. In the writer's series, it was responsible for 8 per cent of the total mortality. Gosset, Desplas and Bonnet<sup>3</sup> reviewed 111 cases, mostly spontaneous perforation of the gall bladder into the peritoneal cavity in which operation was performed. The mortality was 52.2 per cent. They concluded that frank perforation of the gall bladder is much more serious than perforation of gastric or duodenal ulcer. Meissner<sup>4</sup> reported 12 cases of rupture of the common duct with 8 deaths and 7 cases of rupture of the hepatic ducts with 5 deaths. Reports from other sources simply confirm the data already quoted.

For a long time it was assumed that the bile itself was relatively harmless and that the lethal symptoms were due to bacterial infection present in the bile. As long ago as 1909 Sellands<sup>5</sup> showed that 15 c.c. of auto- or hetero-bile injected intraperitoneally into rabbits weighing 1000 gr. caused death in a few hours.

O. H. Horrall has recently reviewed this subject and has added a considerable amount of experimental data and his work has, I believe enabled the clinician to form a clear-cut and accurate concept of the situation. His results may be summarized as follows:

Bile in the peritoneal cavity acts as a true chemical poison. In dogs 5 c.c. or more per k. of body weight causes death within twenty-four hours. Sterilized bile has the same effect as unsterilized bile. Sublethal doses produce toxic effects commensurate with the quantity of bile entering the peritoneal cavity. As regards the treatment of bile peritonitis in the dog, Horrall says:

In a number of dogs the gall bladder was opened and left open as in the early operations, and after varying intervals of time the abdomen was aseptically reopened and the gall bladder closed. Various intervals of time

were set for the closing of the gall bladder, all of which must be within twenty-four hours. At the time the gall bladder was closed, the peritoneal cavity was thoroughly washed out with sodium chloride solution and a quantity of the solution was left in the peritoneal cavity. The dogs in which the second operation was done at eighteen hours all died; one lived at sixteen hours; all lived at twelve hours or less. Apparently, then, the maximum time at which the operation can be done following rupture of the gall bladder is sixteen hours; the preferable time is twelve hours or less.

Seven deaths are listed as due to subdiaphragmatic abscess. This condition is very rarely recognized clinically. On the other hand, it appears to be rather frequently found at autopsy. I believe that it is a more frequent complication of gall bladder operations than the figures would indicate. Its frequency can probably be reduced by careful operative technic and efficient drainage.

One hundred and forty-nine deaths or 30 per cent of the total are listed under causes directly associated with the biliary pathology encountered at operation. The deaths due to perforation of the gall bladder or ducts have already been discussed and are included in the 149 cases. It is impossible to state how many of the other peritonitis deaths were really associated with the disease itself rather than with the operative interference. With these added, it is safe to say that something over one-third of the deaths recorded in the combined series can be traced to the results of the disease itself.

The greatly increased operative risk in the presence of jaundice has always been recognized. In the combined series, 42 deaths are listed as due to cholemia with or without postoperative hemorrhage and 19 as due to hepatic insufficiency following for the most part operations performed in the presence of duct obstruction. Twenty, or approximately half of the deaths listed under cholemia were due to postoperative hemorrhage of the uncontrollable oozing type characteristic of

<sup>3</sup> GOSSET, DESPLAS and BONNET. *J. de chir.*, 25: 257, 1925.

<sup>4</sup> MEISSNER. *Beitr. z. klin. chir.*, 54: 204, 1907.

<sup>5</sup> SELLANDS, A. W. *J. Exper. Med.*, 11: 786, 1909.



this condition. Since the introduction by Walters of the  $\text{CaCl}_2$  method of controlling hemorrhage in the presence of jaundice, we have at our command a means by which a very considerable proportion of the deaths from hemorrhage associated with cholemia can be prevented.

Nineteen deaths are ascribed to cholangitis or liver abscess apparently secondary to cholangitis. It seems probable that cholangitis was an important contributing cause of death in a number of cases listed under other headings.

Common duct stones overlooked at the time of operation were given as the cause of death in 2 cases.

Pyemic processes such as multiple lung abscesses, splenic abscesses and secondary abscesses in other parts of the body account for 16 deaths. This represents only approximately 3 per cent of the total deaths and in some of the cases here included the relation of the pyemic infection to the gall bladder pathology or the operation is rather doubtful. The low incidence of infection per se as a cause of death following gall bladder operations would seem to indicate that infection plays a secondary, rather than a dominant, rôle in the pathological processes associated with this field of surgery.

Acute pancreatitis is listed as the cause of death in 7 cases. The association of acute pancreatitis with gall bladder conditions has long been fully recognized.

Cirrhosis of the liver is given as the cause of 5 deaths, acute infection in fulminating cases 2 deaths, pancreatic asthenia 1 death and exhaustion 4 deaths.

Pneumonia and acute pulmonary complications account for 53 deaths. In the writer's series, pulmonary complications accounted for 6 per cent of the deaths, whereas in the literature pneumonia is given as the cause of death in approximately 12 per cent of the cases. Unquestionably pneumonia is one of the most important of the dangerous complications of gall bladder surgery. Its high incidence in this field of surgery is probably depend-

ent upon a number of factors, such as the relatively advanced age of a large proportion of the patients, the high incidence of obesity and the fact that following the operation free movement of the diaphragm is often painful. It is the writer's opinion, however, that the pneumonia as listed in the cases collected from the literature was often a purely terminal event rather than a primary determining cause of death. As already stated, I would be inclined to transfer to the high temperature rapid death group, 2 of the 6 cases in my series listed as pneumonia. If the high temperature rapid death syndrome proves to be a true clinical entity, it seems probable that in the future a good many cases now listed as terminal pneumonia with the diagnosis based largely on a high terminal respiratory rate will be classified as high temperature rapid deaths.

Cardiac and myocardial conditions are given as the cause of death in 34 cases. Considering the age, obesity and general condition of many of the patients, this appears to be a low incidence for this type of death.

Renal failure, chiefly anuria, is given as the cause of death in 24 cases.

Diabetic coma is mentioned as the cause of only 1 death. Considering the frequency of diabetes during the age periods which furnish most of our gall bladder patients and the supposed relationship between chronic pancreatitis and cholecystitis, the extreme rarity of diabetic coma in association with gall bladder surgery is, I believe, worthy of emphasis.

Among the other miscellaneous deaths associated with conditions not directly related with the gall bladder, there was 1 death from thyroid intoxication, 1 death from thrombosis of the iliacs and vena cava, 4 deaths from complications of other operations, 2 deaths from cerebral hemorrhage, 1 death from acute hepatitis associated with alcoholism and 2 deaths from acute mental conditions.

Twelve deaths were listed as due to undetermined causes.

# RIGHT-SIDED TRAUMATIC HERNIA OF THE DIAPHRAGM

OBSERVATIONS ON A CASE\*

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IN the mass of surgical conditions commonly met, diaphragmatic hernia in itself is still so sufficiently infrequent as to arrest attention. At the Mayo Clinic it is said to occur once in 23,000 cases, and as in a series of 276 cases collected by Lacher it was found to occur on the right side in only 15 per cent of the total, the assumption that a right-sided hernia is sufficiently unusual to merit reporting may be justified.

The fact that most diaphragmatic hernias are left-sided is due partly to the protection on the right side afforded by the bulk of the liver. Occupying as it does the right dome of the diaphragm, the liver serves as a barrier at this site to the passage of abdominal contents into the right pleural cavity. The structure of the diaphragm itself however, is also of importance in favoring the preponderance of left-sided hernias. Arising from fleshy muscular slips from the ribs and sternum on the sides and anteriorly, the crura and arcuate ligaments posteriorly, it is inserted into a trilobed central tendon. This tendon occupies proportionately more of the right and anterior aspects of the diaphragm than it does of the left vault. Muscle fibers which can be separated or split offer less resistance to the passage of a hernia than tendon, and as the left lobe of the central tendon is the smallest of the three, there is proportionately more opportunity for a hernia to develop on the left side than anywhere else.

Hernias tend to protrude through the diaphragm at the site of normal apertures, such as the foramina of Morgagni at the junction of the sternum and the seventh costal cartilage on each side, and the foramina of Bochdalek, posteriorly, between the lumbar and costal divisions of the

diaphragm. Their most common site however, is through the esophageal opening. This aperture, slightly to the left of the midline and one of the three large normal openings of the diaphragm, is elliptical in outline and is the only one of the three that is muscular in structure, thus lending itself to dilatation from increased abdominal pressure beneath. The opening for the vena cava at the right is protected by the liver and is tendinous in structure while that for the aorta besides being of a tendinous nature, formed by the decussation of the crura, is really behind rather than in the diaphragm. These considerations probably account for the fact that while diaphragmatic hernias through the esophageal opening are the usual type, none has ever been reported as occurring through the opening for the aorta or the vena cava, and that while hernias in general usually enter the left chest and often force their way into the posterior mediastinum, they are rarely seen occupying the right pleural cavity.

Diaphragmatic hernia usually is divided into the following types: congenital, acquired and traumatic, a differentiation which is important not only from the standpoint of the suitability for surgical treatment, but in these days of compensation awards, from the standpoint also of the part that industrial accidents may play in their production. In the congenital type, and in such cases there may be congenital defects elsewhere, there is imperfect development, with lack of fusion of component parts of the diaphragm, with resulting open defects through which abdominal organs make their way into the thorax. Such hernias have no sac. In the acquired type, the hernial mass, covered

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by peritoneum and parietal pleura, forces its way between the muscle fibers of the diaphragm at a weak spot, usually at the site of a normal opening, until it comes to occupy a thoracic position while the traumatic cases arise from injury of the diaphragm, the result of stab or gunshot wounds, fractures of ribs, falls or crushing injuries of the thorax or abdomen. Traumatic hernias are usually at the periphery, whereas the other types are commonly centrally located.

In a succinct analysis of 378 cases in which operation was performed, 19 of which were at the Mayo Clinic, Hedblom found even on excluding the war cases, that most diaphragmatic hernias are traumatic in origin. His figures are as follows:

	Per cent
Traumatic.....	60.1
Congenital.....	14.7
Acquired.....	14.8
Indeterminate.....	10.3

Thus, as he states, of reported civilian patients operated upon, two-thirds of the cases are traumatic, one-sixth congenital and one-sixth acquired. In a considerable number of the traumatic cases however, there is a latent period between the injury and the onset of symptoms, and in a large proportion, months or years may elapse before operation.

In eventration of the diaphragm, which is not a true hernia at all, owing to extreme atrophy, with fatty degeneration of the muscular fibers, the diaphragm like a thin membrane yields to the pressure of the stomach and intestines below it, and together with them is displaced into the thorax. This condition may be the result of insufficient muscular development, may be due to trauma, may result from injury to the left phrenic nerve or be a part of a poliomyelitis. Surgical treatment is obviously futile and the difficulties of a correct diagnosis apparent.

One peculiar type of diaphragmatic hernia, the so-called paraesophageal type, of which up to 1924 only 6 cases had been reported in the literature, is probably the

result of a congenitally short esophagus. One such case at autopsy showed the esophagus to be 19.5 cm. in length from the cricoid cartilage (normal average length 23–25 cm.), with the fundus of the stomach herniated through the esophageal opening, lying in the right chest, the greater curvature to the right, the lesser to the left and the pylorus extending back into the abdomen through the hernial opening. Moreover, 3 cm. above the hernial opening was a perforation of a gastric ulcer! This type of hernia is mentioned here only because of the futility of surgery in such a case, as due to the shortness of the esophagus reduction of the hernia is impossible. It seems proper therefore to determine pre-operatively by x-ray the length of the esophagus in cases of diaphragmatic hernia as a guide to the possibility of surgical relief.

The symptoms of a diaphragmatic hernia of any type fall into two main classes, abdominal and thoracic, for there is not only an impairment of function of the abdominal viscus imprisoned in the hernial mass, but an interference as well in the free action of adjacent organs both thoracic and abdominal. The urgency of symptoms does not depend so much upon the size of the hernia, as upon the degree to which it has become adherent, its effect upon the esophagus blocking it or causing an incompetency of the cardioesophageal opening or its obstructive effect upon the stomach or bowel.

Substernal pain, vague gastric distress, vomiting and constipation are the commonest symptoms referable to the gastrointestinal tract. These symptoms may come on only at night, when the patient is lying down, or there may be morning vomiting or acid regurgitation due to incompetency of the cardioesophageal opening. Dyspepsia or indigestion may occur and give rise to a tentative diagnosis of ulcer or gall bladder disease. There may be attacks of recurring intestinal obstruction or there may of course be evidences of strangulation.

Among the thoracic symptoms cough and cyanosis are probably the most common. Dyspnea is not so frequent, but may occur along with pain, palpitation, hiccup and other symptoms of thoracic intrusion.

These various symptoms both thoracic and abdominal, may of course be present from the onset with all the evidences of shock to complete the picture of a serious trauma. Prompt intervention may be demanded. On the other hand, the symptoms may gradually develop, certain ones predominating according to the type and location of the hernia. Or, at some subsequent date, after a quiescent period an emergency may suddenly arise. So long as strangulation does not occur, the presence of abdominal organs within the chest is not incompatible with life, but ordinarily such a condition does incapacitate an individual, impairs health and in many cases terminates in strangulation.

Like that of many other conditions, the diagnosis of a diaphragmatic hernia often depends primarily upon the suspicion that it may be present. It is often missed because not suspected, but with its possibility in mind a careful history should be made, with proper evaluation of the symptoms and a search for or discovery of suggestive signs. The diagnosis should at least be suggested even before resort to the x-ray. The commonest signs are:

1. Tympany or dulness over the lower thorax.
2. Splashing or gurgling sounds, due to distended stomach, and
3. Heart displacements, usually dextrocardia.

The presence or absence of Litten's sign, asymmetrical movements of the costal margin and variations in the subcostal angle, as emphasized by Hoover, often assist in the differentiation of conditions characterized by elevation or depression of the diaphragm, as for instance, in the differentiation between subphrenic abscess and pleural effusions. But they may also be of value in determin-

ing impairment of the diaphragm due to the presence of hernia.

The x-ray of course, is of vital importance. In the ordinary x-ray of the chest however, the shadow may be mistaken for pneumothorax, pulmonary abscess, tumors of the thorax, thickened pleura, pleuritic bands, esophageal diverticula and other conditions, so that unless the possibility of a hernia is suspected, with the subsequent administration of an opaque meal, the diagnosis still may be missed. In every case of penumothorax or dextrocardia, hernia of the diaphragm should be suspected until disproved.

To make the diagnosis in these cases is of considerable importance for two main reasons. In the first place, as the existence of a diaphragmatic hernia often gives rise to symptoms common to other abdominal disorders, a correct diagnosis will prevent needless operations on other organs; in the second place, in those cases amenable to surgical treatment, a correct diagnosis with reparative surgery will forestall incarceration with its vastly increased operative mortality. Many of these cases, especially of the traumatic type result sooner or later in intestinal obstruction and strangulation. In Hedblom's series, 33 per cent of the cases strangulated and in 36 cases not operated upon, Lacher states that strangulation occurred with a fatal outcome as follows:

5	on the first day
10	within a month
5	within five years
5	within twenty years.

Thus it is evident that strangulation, whether early or late, is a distinct menace and its prevention is a sufficient indication for operative interference.

The operative approach in the diaphragmatic hernia is thoracic or abdominal or a combination of both, with the lowest mortality occurring in the thoracic operations. In cases of obstruction in which the cause is uncertain, a laparotomy of course is indicated. If a hernia is known

to exist and the opening in the diaphragm has been shown to be parasternal, a laparotomy here also is best suited to meet the conditions. Otherwise the thoracic route is usually preferable, gives a slightly lower mortality and offers a better chance for a successful closure of the hernial opening. In Hedblom's series, the total operative mortality was 33.6 per cent, that in obstructed cases being 53.1 per cent and in the non-obstructed cases 23.4 per cent. According to the operative approach, the mortality in laparotomies was 42.9 per cent, in thoracic operations 19.8 per cent and in the combined operation 26 per cent. The cause of death in most cases is shock, next in importance in the laparotomies being peritonitis, and finally in both types of operation empyema and pneumonia. Pleural effusion is the commonest complication in either type, which is frequently non-purulent but may go on to empyema.

The reduction of the hernia is often difficult as indicated by the numerous procedures resorted to for that purpose. Digital dilatation or incision of the hernial ring, deflation of the stomach by means of a stomach tube or even aspiration through the gastric wall, resection of the omentum and the induction of pneumothorax to overcome the suction effect of the negative thoracic pressure have all been employed. It is possible that spinal anesthesia by its lessening of the caliber of the gut might also be of material assistance in facilitating the reduction.

If reduction is impossible, a gastroenterostomy is sometimes indicated, or enterostomy in cases of obstruction. When possible the hernial opening should be repaired by suture or some plastic procedure, or if it cannot be completely closed, the omentum, stomach, spleen, liver or colon may be sutured to it to close the gap and prevent recurrence. The aspiration of air from the pleural cavity at the completion of the operation will facilitate the expansion of the lung.

#### CASE REPORT

G. B., an adult Swede, fifty-three years of age and a carpenter by occupation, admitted to the Mary Immaculate Hospital, Jamaica, N. Y., on March 11, 1929. While framing a second-story window, he had slipped and after a fall of 14 to 16 feet, had landed across a 3 in. beam striking and severely injuring the right side of his chest. After being brought to the hospital in a moderate degree of shock, he was able nevertheless to walk into the ward, though slightly cyanotic, with an irregular pulse of poor quality and complaining of severe pain in the right chest. Occasional coughing spells with an expectoration of thick, yellow mucus, accompanied by cyanosis and rapid, shallow respirations, were a definite feature of his initial symptoms. When he was admitted, examination of the chest showed a slight deformity in the contour of the right side with apparent depression and limitation of motion on respiration. Tenderness was marked and on palpation subcutaneous emphysema was elicited as well as crepitus over several ribs. On percussion there was hyper-resonance over the lower right chest posteriorly and especially in the midaxillary line. The apex beat of the heart was in the sixth space, 5 in. from the midsternal line. At this time there was no suspicion of a diaphragmatic injury, though moderate rigidity of the abdominal muscles in the right upper quadrant together with the character of the injury and the patient's general condition naturally suggested the possibility of trauma to the liver, kidney or other abdominal organs. There seemed however, no indication for operation, though patient vomited several times and in fact, for the first three or four days vomited persistently. The admission blood count showed a leucocytosis of 15,000 with 85 per cent polymorphonuclears.

An ordinary x-ray of the chest as taken the following day, the report of which was as follows: "Fracture of the 2nd rib in the midaxillary line. Comminuted fractures of the 10th and 11th ribs  $1\frac{1}{2}$  inches from the spinal articulation. Fractures of the 7th, 8th, 9th and 10th ribs in the mid-axillary line with moderate displacement of the fragments. The costophrenic angle on the right side is moderately obscured. Above this is an area of diminished density, greatly simulating a pneumothorax. The right lung is displaced upward and inward toward the mid-line." Aside therefore, from

the diagnosis of multiple fractures of various ribs and the presence of an exudate, probably sanguinous, in the right chest cavity, there

A few days later when the patient was able to tolerate it, a barium meal was given and a gastrointestinal series made, the presence of a

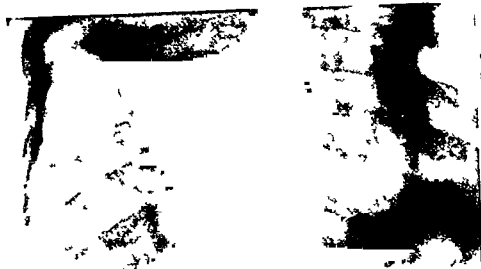


FIG. 1.



FIG. 2.



FIG. 3.



FIG. 4.

FIG. 1. Plain plate showing multiple fractures of ribs. Note area of diminished density, "simulating pneumothorax"

FIG. 2. Three hours after ingestion of barium meal. Note pylorus and bulb drawn up toward area of diminished density in thorax.

FIG. 3. Six hours after opaque meal, showing upper portion of ascending colon, hepatic flexure, proximal portion of transverse colon and pylorus herniated into right pleural cavity.

FIG. 4. Six and one-half hours after opaque meal.

was a displacement of the lung and an area of diminished density greatly "simulating a pneumothorax."

The shadows in this particular area however, resembled somewhat the appearance of gas within the bowel and a progress note was therefore made that the presence of a diaphragmatic hernia should be born in mind.

diaphragmatic hernia into the right chest thus being demonstrated. As shown in the accompanying plates, the contents of this hernia comprised the bulb, the upper portion of the pylorus, half of the ascending colon, the hepatic flexure and the proximal half of the transverse colon.

The patient however, refused operation,

and up to the present time with a cessation of most of his symptoms, it has not become urgent. During his stay of eighteen days in

pany which is striking and unmistakable. This man still refuses operation though he realizes that his "kitchen stove is in his bed-room";

FIG. 5.



FIG. 6.

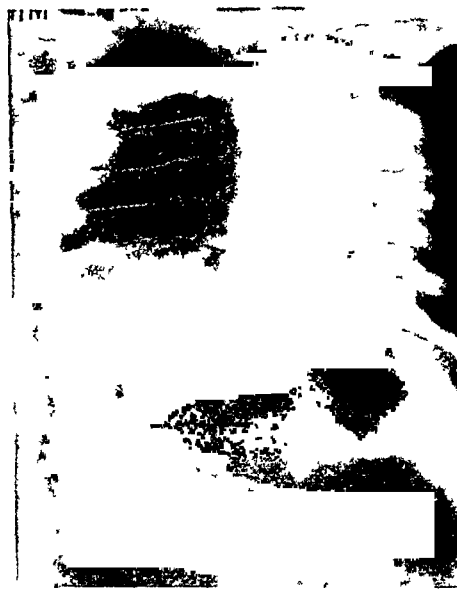


FIG. 7.



FIG. 8.



FIG. 5. Eight hours after opaque meal.

FIG. 6. Twenty-four hours after opaque meal, showing evidence of hemothorax as well as protrusion of gut into pleural cavity.

FIG. 7. Twenty-four hours after opaque meal, showing constriction of colon at hernial ring.

FIG. 8. Twenty-four hours after opaque meal, showing colon high in thoracic cavity.

the hospital, his condition gradually improved, but for three months after his discharge patient had occasional vomiting spells lasting sometimes two days. Since then he has now been free from vomiting, but he still complains of pain, occasional cough and shortness of breath on exertion. Expansion of the right chest is still impaired, breath sounds are still diminished at the right base, there is dullness posteriorly up to the sixth rib, the liver dullness anteriorly is normal, but between the two in the midaxillary line is a definite area of tym-

and from the compensation standpoint, in spite of the history of extensive injury, multiple fractures of ribs at the site of hernia, the development of hemothorax, the symptoms of cough and vomiting together with cyanosis, and the demonstration of a hernia through the periphery of the diaphragm, the question is still being argued as to whether the hernia if it exists at all, is traumatic or congenital.

[NOTE: For references see author's reprints.]

# THE ROENTGEN-RAY DIAGNOSIS OF POLYPI OF THE MAXILLARY ANTRA\*

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THE roentgen-ray examination of the paranasal sinuses is being used so extensively that it has become almost a routine procedure by many rhinologists in cases where there is the slightest doubt as to the pathology present. This is especially true in those cases where one is searching for a hidden area of focal infection. A considerable percentage of such cases are without symptoms and the x-ray is used for an analysis of the anatomic and pathologic picture.

Polypi of the maxillary antra occur much more frequently than was formerly believed. This difference in the number found has largely been brought about by the evidence disclosed by the roentgen examination. These polypi may be seen in profile by plain films of this area or indirectly by the pressure defect produced on a column of an opaque medium injected into the antrum.

The structure of the mucous membrane of the antrum is such that, when it is exposed to acute and chronic inflammation, polypi are prone to develop locally. These polypi may or may not be associated with nasal polypi, but are more apt to be sessile than pedunculated as is often the case with nasal polypi. They may fill the antrum and protrude through the orifice and give the appearance of nasal polypi, in which case, of course, intranasal excision is of no avail. Much debate has ensued over the question of the relationship of these polypi to true neoplasms; but it is impossible here, as elsewhere, to differentiate clearly between the products of chronic inflammation and neoplasms.

Grossly, they are usually a mass of soft, edematous, polypoid tissue having a somewhat pinkish color. They may, however, be tough and stringy with a more

solid consistency. They also frequently show lobulation. Microscopically they are often covered with columnar epithelium which may show some desquamation. The glandular structures may show hyperplasia. There is usually an inflammatory edema present. Sometimes the cellular infiltration predominates and sometimes the edematous reaction is more marked. Eosinophilic infiltration of high degree is often present.

The relationship between chronic disease of the paranasal sinuses, and upper respiratory infections, various lung conditions and asthma has been repeatedly described. It has been found that it is in these cases of chronic sinus disease, where the symptoms of the disease are so slight and where the washings from the antrum often return clear, that one must look for the source of many secondary diseases of the respiratory tract.

There is little doubt that many cases of these polypi and mucocoeles are the result of chronic inflammatory processes in the antrum. The amount of polypoid formation, however, is not always in proportion to the amount of secretion present. Some have observed that in the pronounced suppurative processes one is less likely to find this condition than in the mucopurulent affections. In certain cases with very large polypoid growths secretory disturbance may be scanty or absent.

The best position for examination of the antra is that described by Waters and Waldron<sup>1</sup> in which the chin rests on the film holder and the nose is raised sufficiently to throw the base of the skull below the antra, thus giving an unobscured view of these. The lateral view is also useful in certain cases.

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Formerly plain films were made of these areas but since the introduction of lipiodol, by Sicard and Forestier, in 1922, for the

antrum obliterates the shadow of the polyp on the roentgenogram. In such cases the rounded pressure defect of the

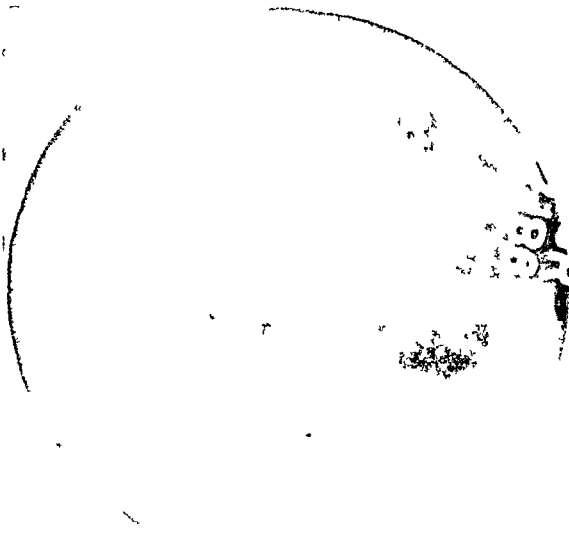


FIG. 1. This shows a large round polyp in the left antrum.



FIG. 2. Same case as Figure 1, showing displacement defect in lipiodol shadow.

outlining of hollow bodily cavities, it has gradually been used more and more in the paranasal sinuses. It is of particular value in the antra as polypi are prone to

column of lipiodol gives evidence of polyp formation just as a similar mass in the stomach produces a defect of the barium column.

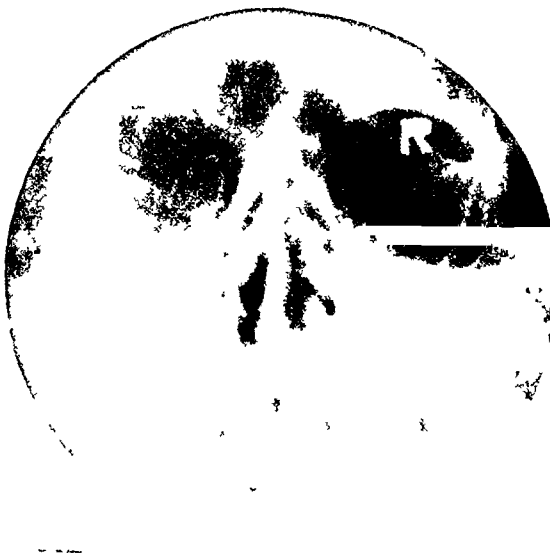


FIG. 3. Pressure defect in base of right antrum.



FIG. 4. Same case as Figure 3. Plain film showing polyp in right antrum.

develop in antra which have been the seat of inflammation, and therefore the mucous membrane in many cases is so thick that the resulting clouding of the

In the introduction of the lipiodol the direct injection is ordinarily used for the antrum as opposed to the suffusion method

which is most useful in the other paranasal sinuses. The lipiodol is diluted with olive oil or liquid petrolatum until the iodine

The diagnosis of antral polyp is made from the roentgenogram when a more or less rounded or dome-shaped shadow is

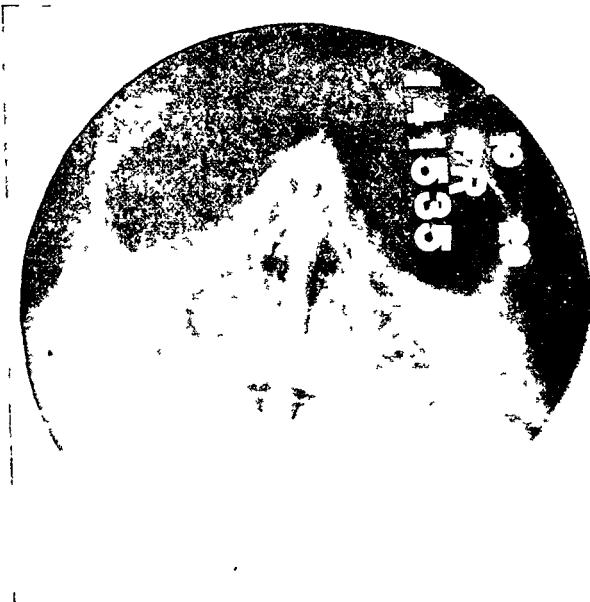


FIG. 5. Plain film showing polyp in base of left antrum.

content is from 10 to 15 per cent. This can be injected at the time diagnostic drainage is done without any particular additional discomfort to the patient. With

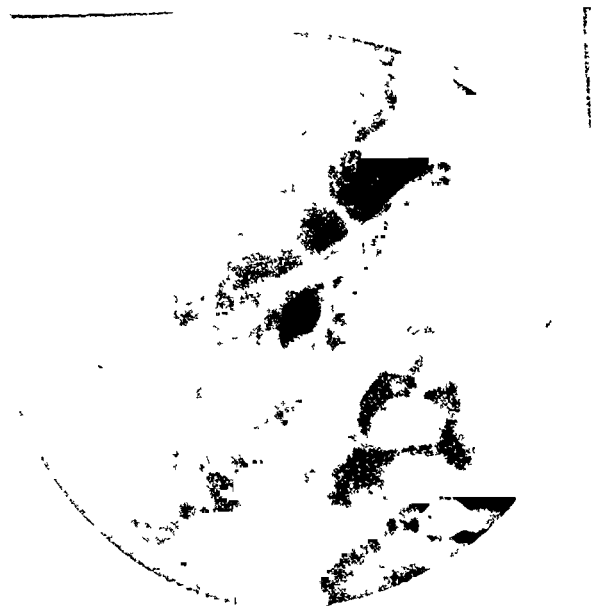


FIG. 6. Same case as Figure 5, showing lipiodol appearance in lateral projection.

seen in an antrum which is otherwise air-containing. These occur most frequently in the base and on the lateral margins,



FIG. 7. Plain film showing a polyp in base of left antrum.

packing in the nose, the patient can then be transported to the x-ray department without any appreciable loss of the opaque medium.

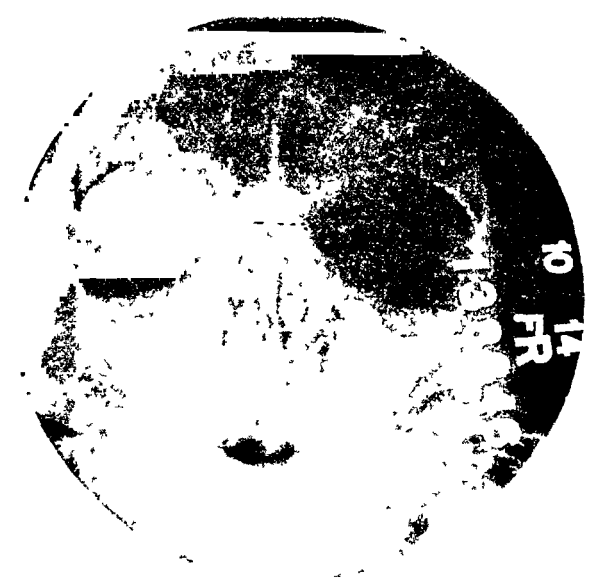


FIG. 8. A case of polyp on medial wall of right antrum shown only by lipiodol.

but they may occur in any part of the antrum. A clouding of the entire antrum, especially if of uneven density, in a patient

with chronic recurrent infection usually means polypoid formation, and it is in this class of patients particularly that lipiodol is of value. The lipiodol injection also shows the thickness of the mucous membrane lining of the antrum with an exactness that can be obtained in no other way. In some cases with the aid of lipiodol a thickened mucous membrane will be found with only one small area showing beginning polypoid degeneration.

In a series of these cases in which we have reported antral polypi from plain films 21 cases have been operated upon and the diagnosis confirmed in 19 cases, or 91 per cent. It might be noted here that in one of the two unconfirmed cases, the operative notes are such that one might infer that some polypoid tissue was removed although it was not definitely named as such. In this case the roentgenogram was usually definite.

In another series in which the diagnosis of polypi was made with the aid of lipiodol 20 cases were operated and polypi removed from 19 of these cases with a correct diagnosis in 95 per cent of the cases.

In still another series of 15 cases the diagnosis was made from the plain films and confirmed after lipiodol injection. At operation all of these cases yielded polypi with a correct diagnosis of 100 per cent.

From this series it is seen that a correct

diagnosis can be made from the roentgenograms in a very high percentage of cases. In a series reported by Drea,<sup>2</sup> using plain films only, there were 19 operative cases with polypi found in 18, or 95 per cent. In a series of 7 operative cases reported by Waters and Doub<sup>3</sup> polypi were found in 5 cases and mucocoeles in 2 cases. Inasmuch as a differential diagnosis between these cannot be made from the roentgenogram, this would be counted as 100 per cent correct diagnosis.

#### SUMMARY

From a review of the literature and of our cases, it becomes evident that the roentgen-ray examination of the maxillary antra is a very definite aid in diagnosis, particularly in those chronic cases with few localizing symptoms. An additional advantage is gained by an examination following the injection of the antrum with lipiodol. Polypi of the antra and thickening of the mucous membrane are shown with a high degree of accuracy as proved by the reported operative statistics.

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# THE X-RAY DEPARTMENT OF A TEACHING HOSPITAL\*

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FOR two decades or more the subject of this symposium has been under discussion by teachers of radiology, so it is scarcely to be hoped that in today's remarks anything essentially new can be added. Rather, we may hope to crystallize thoughts advanced on various occasions at meetings of the national societies devoted to the specialty of radiology and at previous meetings of the nature of the present one, sponsored by the American Medical Association, the American College of Surgeons and the American Hospital Association.

The teaching of radiology is a subject on which complete agreement has not been reached. That it should be taught is taken for granted, but how much effort should be devoted to making radiologists out of undergraduate students, or even graduate students not specializing in radiology, is not agreed upon. Undergraduate, and even graduate, teaching requirements differ much from those of institutions or departments devoted to the instruction of prospective radiologists. The latter require knowledge of a wealth of detail relating to technical matters, electrical and mechanical principles and apparatus involved in the production and manipulation of the roentgen rays, as well as the needed medical training and experience. Further, the radiological specialist must spread this training and experience over a large field, embracing almost every branch of medicine. Like pathology, medical radiology finds application in a large percentage of patients; indeed, radiology may be likened to pathology *in vivo*. It is patently impossible in any scheme of undergraduate or rotating internship teaching to expect to give the student the necessary preparation to practice radiology.

The purpose, then, of a department of radiology in a teaching hospital should be to furnish the appropriate assistance in the routine examination and therapeutic management of patients; to participate in staff conferences; to contribute to the instruction of internes and undergraduate students on the application of radiology to the problems of diagnostics and therapy—on the possibilities as well as the limitations of the roentgen ray aid; to help in various research problems as they present themselves; and to assist in post-mortem examinations.

Parenthetically, it is proper to call attention to the fact that the hospital management should not look upon the radiological department as a profitable investment, and it should not be the aim of the department to contribute to the financial standing of the institution until all the foregoing objects have been achieved. There is no more justification for the hospital to capitalize the experience of the radiologist, than to put the operating room on a fixed fee basis, pay the surgeons and nurses salaries, and credit the profits to the income of the hospital.

In order to meet the foregoing aims, the physical equipment of the hospital should include standardized x-ray equipment for radiography and fluoroscopy and for x-ray therapeutic work, housed in rooms of sufficient size to permit demonstrations to students and internes. Instruments for biplane fluoroscopy to be employed in the setting and splinting of fractures, a combined roentgenoscopic and roentgenographic cystoscopic table, a special table for gynecological x-ray studies, such as salpingography, hystero-graphy and inflation of the uterine tubes, and proper equipment for high tension deep therapy are

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almost necessary in a large hospital, whether or not employed for teaching students.

The personnel must include a medical radiologist, with such physician and lay assistants as the volume of work demands. The larger hospitals may justify a staff of radiologists, so that under the director of the department, who may elect some specialty of medicine in which to expand his radiological effort several associates may be developed with special aptitude in the radiology of other specialties, so that the entire field of medicine may be covered with a maximum of radiologic service.

The hospital management must not look upon the radiological department merely as a photographic center for the production of pictures to be interpreted by the various surgeons, internists or other specialists who may have ordered the x-ray studies. There is a growing tendency to look upon the x-ray department as just such a photographic center, where patients are sent to have roentgenograms made, after which the resulting concrete records are asked to be sent to this or that ward or to this or that office, where the original referring physician often appears to be willing to make his own readings and seems perfectly content to assume full responsibility for the radiological diagnosis. Precedent for this was established long ago in regard to roentgenograms of fractures and dislocations, and often times with foreign bodies, and has come to be considered in many quarters as the perfectly proper procedure for the orthopedic department; but we should recognize it as the beginning of a new departure. We should look well ahead to see whither it leads. Does it mean that the chest films are to be sent to the chest department, the gastrointestinal films to the gastroenterological department, the head films to the neurological department, etc.? If so, what other future can be seen for the roentgen department than as a photographic laboratory, and what need for an experienced physician-radiologist

in such a place? Such a scheme would scrap the benefits of fluoroscopy, unless the radiological department, like an operating room, be opened to all members of the hospital staff, and, even then, the average efficiency of the screen work would be low. My firm belief is that such a development would result in setting back the clock of radiological progress many years, for it would mean abandonment of all help obtainable from screen examinations by a physician-radiologist with his accumulated experience of many years in examining patients from all departments of a hospital. There is little tendency for the radiologist to fall into a rut, to see problems from a single angle, for he is constantly influenced by the diverging opinions of his colleagues in all departments of the hospital, and has a better opportunity than most physicians to realize fully the fault of getting into a rut, and the need of maintaining a receptive mind.

The above remarks should not be interpreted as intimating that an internist, a surgeon, or any other specialist has not a perfect right to fit himself in every possible way for the practice of this specialty; and if he wishes to utilize the roentgen rays as one of the methods of examination, there can be no logical objection raised to his use of this procedure. It is his need to see that he has had sufficient training under expert tutelage for the radiological work. But if the hospital should be so unwise as to divide up its radiological work, apportioning it out to various departments, there would be lost that great help to physicians, surgeons and radiologists, which comes from frank discussion of the roentgen findings, both screen and film records, between radiologist and referring physician, and their proper evaluation in the light of the clinical aspects of the case brought out in such a discussion.

The reports of x-ray findings should be full of details, but every such detailed record should also contain a line or two of summary for convenient quick reference

and for cross-indexing. It is our custom to attach a copy of the report to the patient's chart, where it is available at all times for study by the students, internes and clinicians, and also to affix a carbon copy of the report to the x-ray department folder containing whatever film records are filed. Cross-indexing provides a means of aiding in research and follow-up, both of which are essential in teaching institutions. The complete record of observations in the detailed report already referred to may prove of great value in future research problems and should form a part of the permanent case records.

The roentgenological diagnosis must be arrived at by a process of reasoning and argument, just like the clinical diagnosis. The films do not come out of the dark room with diagnosis labels filled out. By a process of considering all the possibilities and eliminating them until the probable diagnosis remains, the roentgenologist reaches a conclusion. He may not be able to put a name to a condition which he studies, unless he draws upon other than roentgen evidences for his information, and this is something which I believe should always be done for the advancement of the radiologist but which should never be done in the written x-ray report. The roentgen report should contain only statements which can be substantiated from roentgen evidence. This report will then take its place with the other evidences of the case, from which the clinician in charge will then draw his conclusions; "*but*" (and this is a very important "*but*") if the staff has the slightest interest in the development of a capable roentgenologist with ever increasing usefulness, they will leave no stone unturned to keep him posted in regard to his cases, tell him of his success as well as his failures, send for him when the surgeon or pathologist has let the light of day upon a lesion which has been baffling.

In the light of what has been said, it is apparent that the examination and the interpretation of the examination findings will be all the more valuable and helpful

if the roentgenologist is furnished with the history and such clinical data as are available up to the moment of the roentgen study. This will enable him to focus his attention upon the probable lesion and will permit him to exercise some of the tricks which he may have learned to brush away the fog a little more efficiently than if he is merely asked to examine this or that tract. The roentgenologist, once proved to be a man worth cultivating, should not be treated as though he were a student perpetually on examination and each patient sent to him as a catch problem, but he should be looked upon as a colleague and be provided with every fact likely to assist him not only in the interpretation of the case in hand but also in his development into a better, broader and more useful consultant. The roentgenologist may render valuable help in the early diagnosis of postoperative ileus, in the discovery of subphrenic abscess and in the proper placement of drainage tubes. In post-operative pneumonias and other respiratory complications, the roentgenological films sometimes constitute decisive information. A sympathetic cooperation between the radiologist and the surgeon or internist in these types of cases will result in deviation from the old approved methods and result in valuable research in new methods and in new applications of old methods.

As Barclay has suggested, the roentgen department is full of intensely interesting work; it may be likened to a profusely illustrated book. The illustrations come automatically from all departments of the hospital and from outside patients. The value of the illustrations can be considerably enhanced if there is a close sympathetic cooperation between the pathologist and the roentgenologist; and it would be an advantage if the two departments were physically closely associated.

It transpires in most hospitals that a very large proportion of these cases find their way to the roentgen department, and if the pathologist and the roent-

genologist are working together there is thus afforded a great opportunity for these two workers to see that there is made the most possible out of the wealth of material which accumulates. In this manner, the roentgen department may constitute a bureau of information concerning material available from the unique position occupied by it as a link in so many diagnostic chains. Again quoting Barclay, the roentgenologist has a great opportunity

to help link up scattered units of a hospital which tend to get further and further away from each other, each absorbed in itself and not knowing what goes on in other units; and he should be able to break down barriers which have a tendency to spring up in big hospitals by making the x-ray department a common meeting ground for physicians from all departments of the institution. [For discussion of this paper see p. 1060.]



# THE REQUIREMENTS OF A DEPARTMENT OF RADIOLOGY IN A LARGE MUNICIPAL TEACHING HOSPITAL\*

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THERE is no essential difference between a municipal hospital and an endowed one. Both hospitals have the same objects in view, to relieve suffering, study disease and train young doctors. Endowed hospitals may keep patients for a longer time while undergoing study. Municipal hospitals must discharge patients as soon after their recovery as is practicable. This is especially true of a municipal hospital which does not contain proportionately the requisite number of beds for the community.

For greater simplification the subject here considered is divided into the following chapters:

1. Organization
2. Physical plant
3. Fire hazard
4. Political interference
5. Health of workers
6. Abuse of department
7. Training radiologists
8. Teaching
9. Research

**Organization:** In the organization of a radiological laboratory of the large municipal hospital there must be a chief radiologist, medical assistants, medical internes, technicians, nurses and clerks, depending upon the size of the clinic. The chief should be a well-trained and experienced medical man with a sound knowledge of clinical medicine and surgery and, of course, must be an expert in radiology. The hospital must make it worth his while not only to take the risks of his calling but also to keep himself abreast of his branch of medicine. He must be responsible for all work turned out, materials used, upkeep of apparatus, selection of house officers and safety of patients and working force.

He should have the necessary medical assistants and so subdivide the work of the clinic that each assistant is responsible for his particular division. In some cases the chief should be a man who gives all his time to the laboratory, but this means a substantial salary and the privilege of charging private patients. Often this scheme is not practical and the problem is solved by a part-time man who may still carry on his private practice. Smaller hospitals may be run on a percentage basis but this cannot be done in a municipal hospital because the percentage of non-paying cases runs from 70 to 90 per cent of all the cases seen and furthermore the private patients are usually those who cannot afford to pay more than a small fee. The assistant physicians in the department should not be expected to spend more than a half day because they could not be paid enough to reward them for their time. The resident radiologist, a young graduate, should give all his time and be paid a reasonable salary. The internes are paid in some hospitals but are not as a general rule. One assistant physician should be responsible for all material bought and used and make a monthly report to the chief. Another is responsible for the proper upkeep of apparatus and meters. The resident radiologist, who should be a graduate radiologist, is responsible for the conducting of the department in the absence of the visiting staff. Technicians may be male or female. It has been our experience that hospital work is too exacting and trying for female technicians, and we have found that male technicians accomplish more even though they are not as amenable to discipline. There is now a registry for technicians which is

\* Presented at the Annual Congress on Medical Education, Medical Licensure and Hospitals, Hospital Department of Radiology, February 19, 1930.



endorsed by the Radiological Society of North America, where competent registered technicians may be obtained. The technical staff should be instructed in the theory, practice and dangers of the work. The efficient department gives twenty-four-hour service; therefore a night technician or interne must be available at all times for emergency work. The value of this service is frequently seen, for instance, in cases of children where diagnosis can only be made by x-ray as between a central pneumonia and acute appendicitis.

*Physical Plant:* Roentgen-ray apparatus is expensive to buy and to maintain. Most of the modern x-ray depends largely upon the type of clinic and the personal experience of the radiologist. A general clinic requires several different types of apparatus and it is advisable to have separate rooms, where possible, for gastrointestinal work, chest work, renal work, etc. The installation of apparatus should be supervised by a radiologist who is conversant with all the requirements and dangers of the work. This should never be left to the dealers alone. The current may be direct or alternating. It may be supplied by the hospital power plant or brought in from the local electrical company. Which ever is used, there should be a free single line to the x-ray department with no elevators or other machines on it. This main line must be made of sufficiently large copper wire to obviate any appreciable loss of current. A recording volt meter on the incoming line near the main switchboard keeps accurate record of the voltage delivered to the department. The main switchboard should be in a dry, accessible location. All switches should be labelled and of the safety type. A separate wire from the switchboard to each room insures against breaking down in more than one room. All wires should be carried in conduits. Each operating room should have its own wall switch. At night the main power switch on the central board should be cut out, disconnecting all machines in the department. This is necessary to

guard against outsiders turning on machines during the night and is also a wise precaution in case of fire. Throw switches connecting two rooms with high tension electricity should not be allowed. Portable machines are necessary for examining patients who are too ill to be brought to the department. The actual care of each machine is in charge of its individual technician and once a month all of the machines need servicing by regular service mechanics from the dealer. Every meter should be calibrated once a week with a standard meter. The standard meter should be calibrated about every four months by the manufacturer. Standardization of machines and tubes so as to give as nearly uniform a technic as possible is the ideal method for a large department. Charts posted over the control cabinets giving definite settings for each examination make this possible. The technicians should be required to follow these charts. This means great simplification of the developing room work because time developing of large numbers of films is thus made possible.

The location of the department should be central in the hospital plant, so as to be readily available to all other parts of the institution. The following table illustrates the distribution of cases in our hospital for the year 1929 and emphasizes the need of a central location:

Total ward patients.....	19,463
Total out-patients....	14,385
Total outside doctors' cases.....	4,083

The department should be arranged so as to allow a continuous flow of patients in one door and out another, thus avoiding congestion. Because of the high cost and intricate mechanism, roentgen-ray machines should never be placed in dark or damp places, especially basements. The apparatus must be accessible at all times for workmen. It also is particularly susceptible to dampness. High tension wires attract dust and quickly become fouled unless constantly kept clean. The department is best placed on the first and second floors with ample window space and

ventilation. Elevators should be large enough to carry a ward bed patient with both legs in abduction plaster apparatus. Sliding doors are preferable to swinging ones. The walls should contain thin sheet lead to a height of about seven feet. Control machines are best placed behind lead or lead glass shields, so as to compel the technicians to retire behind this protection while making exposures.

Ventilation and sunlight in every room are quite essential. Some observers believe that poor ventilation and lack of sunlight have contributed more to ill health among roentgen-ray workers than any other cause. Certain it is, that since x-ray departments have been moved out of dark basements, the incidence of impaired health among the workers has greatly lessened. The best arrangement for ventilation is to have an exhaust fan in every room which draws out the foul air through ventilating shafts. This should be supplemented by openings above each window, which may be regulated, for admitting fresh air from the outside.

For dressing rooms the best plan is a row of steel lockers adjoining a small dressing room. The patient undresses in the dressing room, puts on his hospital gown and then places his clothing in one of the steel lockers and locks it. This arrangement does away with the necessity of large dressing room space. It also prevents theft and contamination of one patient's clothing by that of an unclean person.

*Fire Hazard:* This subject cannot be emphasized too much. There should never be a repetition of the frightful holocaust which occurred earlier this year. In spite of all the investigations and reports arising from this tragedy many communities are still as open to disaster as they were before. Many excellent recommendations were made for the prevention of fire and explosion and it is almost criminal not to follow them. Fire and explosion from x-ray films in a hospital filled with bed-ridden patients is unthinkable,

but can we all say that such a calamity can never happen in our own hospitals. If the safety type of film is used the fire hazard is negligible. As a matter of fact, this film is no more dangerous than so much office stationery. The nitrate film should not be allowed in any institution. It is highly combustible, gas-producing and explosive. The safety type of film costs about 20 per cent more than the other, but the added expense is good insurance against fire or explosion. Water is the most efficient agent against fire. Therefore, the entire department should have a first-class sprinkler system, with extra large supply pipes and oversensitive sprinkler heads. Windows in film storage rooms should be made of very thin glass so that they will blow out easily in case of fire, thus letting the smoke and gas out into the air. Fire hose and extinguishers should be placed at strategic points throughout the department. No smoking is allowed. Automatic fire alarms are helpful. Current films must be kept in the department for handy reference but all other films should be stored in a fire-proof out-building. In our state the statute of legal limitation for law suits is six years, and because of this we preserve all films for seven years. Films older than that are not of much use in a given case anyway, because of the changes occurring in most physical conditions over that period of time.

*Political Interference:* This is largely a bugaboo. From my own experience and that of others in similar positions, it is only fair to say that there is no more meddling by politicians than there is by favored friends in other hospitals. We have been told by men of prominence in political life that practical politicians never wish to meddle with hospital organizations or interfere with their purchase of supplies and equipment. All positions should be under civil service regulations. These regulations allow the head of the department ample latitude in selecting his technical help and eliminate the undesirables from

consideration. Selection and purchase of equipment should be in the hands of the director. If he has the confidence of the hospital authorities in his judgement and integrity there should be no difficulty in these matters. There is generally an ordinance requiring that all purchases above \$1000 must be let out on bids. This situation is easily handled by incorporating careful specifications for the bids. The specifications used by the army and navy are excellent models to follow.

*Health of Workers:* The first concern of the radiologist must be the safety of the patient. Each radiographic patient, however, receives such a small amount of exposure that there is practically no danger of over-exposure. The treatment cases, on the other hand, must be surrounded with all the necessary precautions. All treatments must be supervised by one of the radiologists, who understands the dangers. All workers with roentgen ray or radium should have ample time off from duty. One month each year is not too much. They should be instructed to spend as much time as possible out in the sunlight. This vacation problem is a difficult one when working for a municipality, because as a rule vacations are regulated by city ordinance. This ordinance permits of no exceptions and is unfair to workers in hazardous occupations such as ours. Radiologists and their technical help must be watched for signs of physical breakdown. Regular blood studies should be made to discover signs of blood disturbance. If this condition is found, a quick vacation is the best method of treatment. A fairly reasonable amount of sick leave is granted by most cities, but it is not enough for those in hazardous occupations as those filled by our technical help. The United States Government allows all its employees thirty days a year for vacation and the same allowance for sick leave. This is about what our technical help should receive. Responsibility for the health of the working staff is a worrisome burden and the chief of the depart-

ment should be allowed more latitude in regulating their working hours. A recent court decision in New Jersey has placed this responsibility directly upon the employers in a radium factory. If then, we who employ people in this dangerous work are liable for their health we should be allowed to use all the necessary safeguards against physical breakdown. Perhaps I am over-emphasizing this aspect of the problem as far as x-ray workers are concerned, but I cannot place it too strongly before you when radium workers are concerned. The safety measures for x-ray workers are now quite well understood:

1. Lead-lined booths for operators.
2. Lead glass bowls for tubes.
3. Lead-enclosed tubes.
4. Ample distance of tube from operator.
5. Good ventilation and sunlight.

If these simple precautions are taken there is practically no danger to the operators. The radium problem, however, is not so easily handled, especially where the operator must handle needles, either of salt or emanation. These operators must be carefully watched for breakdowns in health.

*Abuse of Department:* The tendency to send cases for roentgen-ray study before being properly worked up is wrong. It lessens the diagnostic acumen of the referring physicians, especially the younger men. It requires the x-ray department to make many unnecessary examinations and hence is an expensive waste of time and material. Furthermore, when these internes go out into private practice they may be located where an x-ray equipment is not available and, therefore, they must make their diagnoses without the help of x-ray.

The signing of requisitions should be done by the visiting physician, except in emergency cases, when the resident or senior house officer may sign them. They must not be signed by medical students or junior internes. Executives in the main office also are allowed to sign them, but they are apt to call for unnecessary examinations, especially after people persuade them

that they wish an x-ray examination. Last year in our gastrointestinal division 50 per cent of the cases showed negative findings. It is reasonable to assume that a large percentage of these were booked for examinations unnecessarily. Our department history taker (a medical student) estimates that about 25 per cent of the patients he interviewed did not require barium studies.

Another annoying problem is the loss of finished films from the record room. These films are taken to the bedside or operating room for convenience of the attending surgeon and are frequently misplaced and lost. My own feeling is that no films should be allowed out of the department and that the visiting physicians should all come to the central viewing room to study the cases in which they are interested. A possible solution for this is to make prints of the interesting cases and attach these to the clinical records, keeping the original films in the department.

It is an established principle that no hospital that is maintained by a state or city should make a profit from medical services rendered to any patient. However, it is advisable that private patients should pay a reasonable fee for private work. Misrepresentation by patients of their ability to pay is, of course, a serious consideration in all hospitals.

The principal means of cutting down expenses is by eliminating unnecessary examinations, which are the greatest cause of needless expenditures. We have derived considerable relief from this annoyance in our out-patient department, by establishing a gastrointestinal clinic: patients referred from any department for barium studies must go through this clinic first, where the need of a roentgen examination is decided. We are also called upon to examine poor patients referred for examination by doctors not connected with our staff. This service is not very large, because all these cases must pass through the hands of one of the executives, who

decides whether roentgen examination is really indicated.

*Training Radiologists:* Up to a short time ago there was more or less difficulty in obtaining high class internes who wished to take up radiology as a specialty. The reason is that the specialty has not yet reached the high place in the minds of medical men that it deserves. This is not true of physicians in contact with good radiologists, for here the true value of the x-ray department as a consulting service is appreciated. Physicians not in touch with good radiologists have an idea that the work consists mostly of picture taking and that anyone can read a roentgen-ray film. This is the principal reason why commercial laboratories are flourishing. As soon, however, as these physicians become acquainted with trained radiologists and appreciate their value as consultants, they see at once that this specialty is a real medical aid in helping to solve their problems.

An interne in radiology should receive at least one year's training. He should preferably be a hospital graduate. This training begins with a course of study and practical work in the technical aspects of developing, lantern-slide making and construction of machines; in other words familiarity with chemistry, physics, electricity and other fundamental subjects. He should do all the emergency work, nights and holidays, at first under supervision but later on, when qualified, alone. He also serves under the different visiting radiologists so as to benefit by their personal ideas and experience. He should work out one original problem during his internship. He is required to follow interesting cases to the operating or post-mortem rooms. In short, his time should be carefully laid out so that after learning the fundamentals he gradually works up and through all the divisions of the work. It is also a good idea to give him some of the responsibility in buying supplies and overseeing the care of machines so as to round out his general usefulness.

*Teaching:* Teaching should be done in all municipal hospitals. Its value as a stimulant to the staff in keeping up to date is undisputed. It would indeed be a pity not to utilize for teaching purposes the wealth of material passing through such a hospital. Nowhere else do we have the opportunity for handling such a large volume of traumatic cases as are brought to the hospital by public ambulances and the police. With the increasing number of automobile accidents each year it is quite essential to train the prospective doctor in the handling of its inevitable train of complicated accidents. A collection of teaching films and lantern slides should be a well developed part of the department. In fact, a good collection of this sort will prove its worth as a reference library of disease and injury. Most of these cases should be checked by biopsy, operation or autopsy findings so as to make them accurate and correct representations.

Another reason for the delay in radiology reaching its proper place in the field of medicine is the attitude of medical schools. Very few of them give this specialty the amount of time or attention in the curriculum to which it is entitled. Teaching is usually done under one of the other branches of medicine. Radiology should have a department of its own. Furthermore, the teaching of many of the other branches may be made more graphic and impressive by the use of the roentgen ray. It is the experience of most teachers of roentgenology that the physiology of the mechanics of the gastrointestinal tract is more satisfactorily demonstrated to students by this method than by any other. Certainly the normal architecture of the human skeleton cannot be shown as well

by any other means. Serial plates of lobar pneumonia and tuberculosis never fail to make a graphic impression on the students' minds.

No attempt is made to teach students roentgenology as a specialty. Rather do we try to have them correlate the abnormal findings with the clinical history and the physical findings in a given case. They are taught the value of interpretation and the amount of reliance to be placed upon it. They are shown enough to enable them to interpret an average film. A brief knowledge of its uses in diagnosis and treatment is about all that can be given to them in their third year. Elective courses for fourth-year students require at least one month's time. This course is more comprehensive and goes further into detail. Post-graduate teaching is given to radiologists who wish to keep in touch with the work of a large medical center.

*Research:* No specialty advances unless research work is being constantly done. As the specialty of radiology is one of the youngest of the medical sciences, the need and opportunity for research are unlimited. Each succeeding year sees newer uses for it. One of the greatest responsibilities of the older radiologists is to encourage and stimulate research problems. Many of the radiologists in the forward looking hospitals require one research problem a year from each of their internes and assistants. The problem may be a small one but if it contributes one new idea it is well worth while. The variety of cases seen in such an institution should be thoroughly studied for the benefit of medical science and the consequent help to mankind. [For discussion of this paper see p. 1060.]



# THE REQUIREMENTS OF A DEPARTMENT OF RADIOLOGY IN A SMALL HOSPITAL\*

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THERE is an old recipe for rabbit pie that begins, "first, catch your rabbit." The first requirement for a department of radiology is to obtain the services of a competent radiologist. It is common practice to equip a department and then look for a director, which is a great mistake. The director should be chosen and given as much latitude as possible in deciding, not only as to type of apparatus, but also organization, personnel and operation of the department, for which he should be held responsible. Where this is not done the directors of a hospital and the staff are bedeviled by the manufacturers, and often are persuaded to put in a more expensive type of machine than required, or a far more complete equipment than is needed. An experienced roentgenologist entering such a laboratory almost invariably finds it necessary to discard or change to a greater or less degree. When he does, the directors are shocked because they have been assured by the makers of the equipment that it is the very latest and best. The director should have the decision, as he must work with the machines and is held responsible for the results.

To obtain a competent director, it is necessary to offer him not only reasonable financial compensation, but satisfactory physical and professional inducements as well. In a small hospital the physical requirements must necessarily vary, not only with the number of beds, but also with the size of the community, the type of work done and the presence or absence of other hospitals in the neighborhood and their facilities. To illustrate, if the hospital is the only one within a reasonably large radius, is doing general work and the staff is a live one, the equipment should

be sufficient to meet any reasonable requirement of roentgen diagnosis. With the present equipment offered by a number of reliable manufacturers, this can be done at an expenditure within the means of any hospital of 75 beds or over. By a reasonable requirement, I do not mean apparatus heavy enough to take stomachs in one-tenth second or chests at 6 ft. in the same or less time. I mean equipment that will turn out diagnostic films of any part of the body, stereoscopically, if desired. It is hardly necessary to add that a fluoroscope for both horizontal and vertical positions is an absolute necessity. If the hospital is in a large community with a completely equipped institution close by or is limited in the kind of work done, the directors must decide, after consulting with their roentgenologist, whether the department should be complete or modified to suit their special conditions. In certain instances arrangement can be made with an institution or private laboratory in the immediate vicinity to take care of special examinations or treatments. One of the most difficult decisions to make is the amount of treatment to be undertaken. The directors of a small hospital, with proper pride in their institution, may want the department to be prepared to treat any patient requiring radiation therapy, considering that the department has failed in its duty if a patient must be sent to another hospital, either at home or elsewhere, for treatment. This is a mistake. To treat all patients needing radiation therapy, and to do it properly, requires an outlay greater than for all the rest of the department. An adequate supply of radium may cost as much as the entire diagnostic equipment, and the addition of a 200,000 volt roentgen

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therapeutic equipment can easily double this. Even more serious is the prescribing and application of the treatment. It is easier to obtain the services of a roentgenologist capable of handling the diagnostic service and even the roentgen therapy than to find one who is also trained in the use of radium. There is no greater tragedy, except incompetent surgery, than ignorant or carelessly used radium, especially when combined with the roentgen-ray. I, not infrequently, see "situation-wanted" advertisements of technicians, who list under experience that they are trained in roentgen therapy. I know of small hospitals where the staff members refer patients to their technicians for a "series of x-ray treatments." Would one of the same staff refer a patient to a nurse for a "course of tuberculin or digitalis therapy?" I doubt it. No treatment should ever be given unless the entire dose, including intervals and all details, be prescribed by a physician who knows what he is prescribing and why.

Of even more importance than the physical are the professional inducements. There is nothing more discouraging to a roentgenologist, especially if he be young, than to be considered by the members of the staff as no more than a high-grade technician. This rarely applies to a large hospital, but not infrequently occurs in the smaller ones, especially if the community is small and is a considerable distance from a large city. One of the first requests a roentgenologist is apt to receive in such circumstances is for "one view of the wrist," "three plates of a barium meal," and "an x-ray diagnosis of the lungs." If he does not make a definite diagnosis of lung tuberculosis with full statement of the degree and probable prognosis, he is considered incompetent. Not long ago I was visiting a young roentgenologist in a small hospital. I was much surprised that, instead of making interpretations of his roentgen findings, he was making positive diagnoses without knowing anything of the patients' histories or physical findings. On being asked how

he could do it, he replied that the staff required definite diagnoses and that he could not retain his position if he did otherwise. He had tried to convince the staff that their attitude was wrong, but was told that the department had been established for the purpose of diagnosis, and diagnosis they would have. No roentgen department can do its duty to its patients or its hospital until the staff will consider its director a colleague, who acts as a consultant when the roentgen ray is used, and that the laboratory is one of the means required to enable them to arrive at a correct diagnosis. The director must be allowed to take such pictures and make such fluoroscopic examinations as he considers necessary to obtain all the information possible with the roentgen ray. Therefore, bills should be rendered for roentgen examinations, not for so many films taken. The director should be limited as to the number taken in any given case. If he is not competent to judge this, he is not competent to be the director. Requisitions for department services should require that an examination be made of such and such a region, and the suspected condition. All other details must be left to the director. This also applies to therapeutics. No requests should be made for "five x-ray treatments of the right breasts," "one x-ray treatment a week to front of the face." They should read "postoperative (or pre) radiation of right breast for carcinoma," or "radiation of right breast for mastitis," "radiation treatment of face for acne." As in diagnosis, the details of technic must be left to the radiologist, and if there are special features, the referring physician should consult with him before treatment is started.

There is a part of the department of radiology that is often overlooked in the large as well as the small hospital, the use of the longer wave radiations. It is common practice to put ultraviolet generators in the physiotherapy department under a technician. This is a dangerous as well as a bad practice and not countenanced by the

American Medical Association. The time allotted to this paper is too short to go into the subject, so this statement will stand without discussion. A physician should be allowed to prescribe the dosage for his patients, if he so desires; but if he does so, he must give all the data, type of reaction desired, etc. and not simply order "quartz lamp, ten minutes, twice a week." Such an order could result in anything from almost no effect, to a severe burn, depending on distance, age of lamp, etc. It is wiser to consult with the director concerning these treatments as in roentgen therapy.

The question of the financial arrangements with the director is often a stumbling block to satisfactory service. In principle, the arrangement should be such that the hospital receives enough from the fees to cover all carrying charges, including the replacement of obsolete equipment. It should not expect to make a handsome profit from the department any more than it would from the operating room. There is usually insufficient work in a small hospital for a full-time man, but whether full-time, or not, the fairest arrangement is a percentage of gross or net income. If either, the hospital percentage should be just sufficient for replacement of obsolete apparatus and additions for a growing

department. Some such arrangement stimulates the director to build up the department and increase his work, both as to quality and quantity.

The equipment of a department by the director at his own expense, and in which, therefore, all fees are necessarily collected by him, becomes, as a rule, essentially unsatisfactory. If he does not satisfy requirements, it is difficult for the hospital to make a change and conversely, it is difficult for him to change if such appears to his best interests. There is one exception, the ownership of radium and deep therapy equipment. In this instance the physician, who will usually confine his practice to radiology, if he is willing to invest such a large sum in equipment, finds it to his advantage to have his high voltage machine in the hospital. It is economically unsound for a small community to have two large equipments operating, one at the physician's private office, and one at the hospital, when there is only enough work to keep one machine running half the time.

There has been no attempt to discuss more than general principles. Each institution must necessarily be an individual problem, but it is believed that these will apply to all. [For discussion of this paper see p. 1060.]





# RELATION OF A HOSPITAL DEPARTMENT OF RADIOLOGY TO THE PRIVATE RADIOLOGIST\*

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IT will be conceded by all that Radiology has become an indispensable aid in the diagnosis and treatment of disease, and that it must be available for the service of patients and aid of the physicians in every well regulated hospital. It is essential therefore that the hospital management make every effort to secure adequate radiological service. While the need for this service is universally understood, there does not seem to be any uniformity of opinion as to just how this is to be brought about. In order to secure the opinion prevailing among radiologists throughout the country a questionnaire was sent to 125 men prominent in this specialty. The information obtained in these questionnaires serves as a basis for the following paper.

A wide variety of arrangements are now in use by various institutions, which seek to provide them with efficient radiological service. These arrangements vary of course with the size and type of institutions which they serve. Some are large enough to require the entire time of a radiologist, others may operate on a part-time basis; some are largely charity institutions, while others may be used entirely for private patients; some may be affiliated with medical schools where teaching of students and internes plays a prominent part in the activities of the department.

It is not within the province of this paper to analyze the requirements of hospital radiological departments, but it is my purpose to point out certain fundamental requirements which are essential to the Radiologist for the successful administration of his department. Well meaning hospital boards who desire to advance radiology as a science would do well to

give their earnest consideration to the manner in which their radiological departments are administered. No radiology department, no matter how elaborately equipped can give adequate service to its clientele or render proper aid to the hospital physicians depending upon it, unless it is in charge of a competent trained radiologist. By competent trained radiologist is meant a graduate physician who has had at least sufficient experience in general medicine to provide an adequate background for his radiological work. His subsequent training in radiological practice should be under some preceptor of acknowledged capability in a large well-regulated laboratory and should be continued until his instructor is convinced that he is capable of assuming individual responsibility. It may be depended upon that in this, as in any other field, his opinion will be valuable in direct proportion to his previous experience. The radiologist should be a man of sufficient experience to render his opinion valuable to the members of the staff with whom he will be called upon to consult. The recent tendency of some institutions to install young men, on small salaries, fresh from their hospital internship without practical medical background or adequate radiological training, as heads of hospital radiological departments to pass their opinions upon matters vital to the welfare of the patient and to consult with established practitioners, is an insult to the intelligence of the physician and an injustice to the patient. This effort by lay hospital boards to reduce the cost of medical care at the expense of the radiologist will be found a dearly purchased economy.

The radiologist should properly be con-

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sidered as a consultant and all of his relations with the medical profession should be considered in the nature of consultations. The same ethical principles which apply to any other medical consultant should apply to him in his relationship with other physicians.

If it is not the opinion of the radiologist that the physician seeks when he sends a patient for examination but merely as x-ray photograph of a certain part, the radiological departments of hospitals may just as well be turned over to lay technicians.

If it is agreed that the radiologist is to be considered a consultant, then he should be given a position on the same footing as the rest of the staff in keeping with the dignity of his position, in order that he may retain their respect and secure their full cooperation. He should be actual director of his department, not director in name only. All department stationery should bear his name as director. He should have charge of all technical procedures and should be consulted in all matters of policy which govern his department. He should have a voice in determining fee schedule for all work done. He should be allowed a percentage of the receipts for the replacement of old equipment, commensurate with the size and income of the department, and should be the sole judge as to when such charges should be made. A certain amount of clinical investigation should be permitted and encouraged. He should, in turn, guarantee competent radiological service at all times, without cost to the hospital management. His compensation should be commensurate with the responsibility of his position and should equal that which he could reasonably expect from similar service in his own private laboratory. The hospital management is entitled to a percentage of the income from the department sufficient to compensate for rental of space occupied, light, heat, janitor service, interest on money invested in apparatus, etc., *but has no reasonable right to expect*

*any profit* from the work done by the radiologist any more than it is entitled to a portion of the surgeon's, clinician's or any other physician's fees from patients attended in the hospital. One often hears it said that hospitals are not "paying institutions" and that as a result they are entitled to profits from the radiological and pathological work which originates in them to help maintain the institution. The fact that many hospitals operate without endowment or other means of support and still are able to show a profit would seem to indicate bad management of non-profitable institutions. Likewise, even where an institution does not show a profit from its earnings, is this any reason why the radiologist should be singled out to help make up the deficit? Diverting a portion of the radiologist's fee to the general hospital fund is no doubt profitable for the hospital; I can conceive of an even more profitable arrangement by which the hospital would hire surgeons and clinicians on salaries and appropriate a portion of their fees.

The basis of compensation should be on the amount of work done; it matters little whether there is an adjustment salary (one which is changed by agreement from year to year on a basis of work done during the previous year) or on a percentage basis just as long as it represents a reasonable method of compensation for the work performed and *does not exploit the services of the radiologist*. An arbitrary fixed method of remuneration at once places the radiologist on the same basis with all other hospital employees, rendering it impossible for him to maintain the dignity of his position as consultant with the staff. Under these conditions he is bound to be considered more or less of a "glorified interne." No man can rise to his greatest possibilities when he does not feel that he is receiving adequate recognition or a fair return for his work. The percentage method for remuneration is by far the most satisfactory since it makes advancement of the department the common interest of

the institution and radiologist. Under this system the greater the amount of work done, the greater the radiologist's remuneration. This system is most flexible since as the work increases the amount of remuneration increases; the amount of time necessary to perform the work must necessarily increase also; after a time it may be necessary for the radiologist to engage an assistant, but in all circumstances the percentage will adjust the difference. If the institution is large, the amount of work done may be sufficient to justify the radiologist in devoting his entire time to the institution; if it is smaller, a part-time basis may be more satisfactory; in either event the percentage basis overcomes all difficulties. If the radiologist is on a full-time basis, he should be granted a contract for three to five years to assure him of the fruits of his labor after he has built up the department. If he is on a part-time basis and is also engaged in the private practice of radiology in his own office, then a hospital contract, although desirable, is not so essential.

Hospitals are institutions for the care and treatment of sick non-ambulatory patients and are supposed to be operated as an aid to the physician in his work. As such, the hospital radiology department should confine its activities to persons entered in the hospitals as patients who by reason of their infirmities are unable to consult a physician in his office or be treated in their homes. The recent tendency of some hospitals and other lay institutions to establish radiological laboratories for the examination and treatment of outside patients, employing a physician as radiologist on a salary, the institution collecting and retaining the fee, is a pernicious tendency which, if persisted in, most certainly will result in the ultimate exclusion of physicians from radiology as a specialty. If this procedure were carried out in all other departments it would place the practice of medicine in the hands of lay organizations and establish a form of contract practice which would

stifle the progress of medicine for at least a generation. It is most important that institutions which profess to operate for the public good should not enter into open, and in some cases ruinous, competition with the laboratories of private radiologists. Operating as tax-free, charitable organizations, often exempt from liability, with relatively low overhead expenses owing to their locations in outlying districts, their ability to engage in collective purchasing and in advertising, their low cost of technical help, they are in a position to cut prices for radiological service to such an extent that no private radiologist can long maintain his position. They are subjects of charitable bequests and often operate under large endowments donated by wealthy individuals. This is almost the unanimous opinion of all radiologists consulted in the questionnaire; the dissenting members were all employees of large clinics. Definite instances are described in the answers to the questionnaires where hospitals operating x-ray laboratories for the service of outside patients have deliberately reduced the price of radiographic examination below cost, making up their deficits from the community fund, actually forcing local radiologists out of business. If only well meaning but misguided hospital boards could be made to see the throttling effect which such methods will ultimately have on the advancement of radiology as a science, they will see that in their zeal to provide the public with cheaper service, they are condemning them to inferior work. Yet I am advised that certain physicians, in some instances former officers of the American Medical Association, posing as hospital experts, propose the installation of this system to hospital managements whose institutions they are employed to survey.

What can be done to remedy these evils?

1. Choose as radiologist in charge of hospital radiology departments men whose clinical background and radiological experience measure up at least in some degree

with that of the staff members who will seek their services.

2. Establish the radiologist in full control of his department without intervention of hospital boards or staff members; permit him to make all charges and collect all fees. The fee schedule for the hospital should be the same as that prevailing in private laboratories of the community, so that if he is a full-time man, he will not enter into unjust competition with his fellow private radiologist; if he is a part-time man, he will not find that he is entering into competition with himself. It should be equally to his advantage to examine a patient in the hospital or in his private office.

3. Treat the radiologist as a medical consultant. The measures already recommended will go far towards maintaining him on this plane.

4. Assure him adequate and just return for his labor. Any attempt to divert a portion of his fee to the general hospital fund constitutes nothing short of fee splitting, if he is on a percentage basis; or contract practice, if he is on a fixed salary, and such a plan if applied to all other branches of medical practice will soon result in passing the control of medical science into the hands of lay organizations.

5. Hospital radiology departments should restrict their services to patients confined to the hospital, and should not solicit outside patients, thus establishing themselves in open unjust competition

with the radiologist who maintains a private office.

I realize very well that it is impossible for anyone to prescribe the conditions under which a man shall or shall not work, and that it is impractical for this committee to specify the attitude which shall be assumed by hospital boards towards their radiologists. I feel sure that these conditions which mar the relationship between the private radiologist and the hospital management have merely been introduced by misguided hospital boards, in an effort to reduce the cost of hospital care, without any due deliberation as to the ultimate effect which they will have on the science of radiology.

The following recommendations are submitted for the committee's consideration.

1. That, only well qualified trained radiologist should be placed in hospital department of radiology;

2. That, once appointed he should be given absolute control of his department;

3. That, he should be considered in all matters as a medical consultant;

4. That, he should be entitled to the fruits of his labor; that it is inadvisable and contrary to the principles of medical ethics for the hospital management to retain a portion of his fee;

5. That, the practice of hospital departments of radiology in entering into unfair competition with radiologists who maintain offices is unjust and should be discouraged as being detrimental to the progress of radiology.



# DISCUSSION OF PAPERS BY DRS. CASE, BUTLER, ULLMANN AND SANTE\*

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THE subjects presented in this symposium were thoroughly covered and since evaluation is difficult, a discussion would be inexhaustible and chiefly philosophical in nature. However, it is apparent that the basic thought revolves around institutional activities for obvious reasons. Firstly, medicine has changed from an "eleemosynary" activity to a commercial enterprise, meaning that it is a method of gaining a livelihood in which there is an exchange of fair values. Naturally all values are ever-changing and require frequent readjustments. Secondly, because medicine is so comprehensive, specialization becomes necessary. Thirdly, instruments of precision are necessary, entailing a large investment and requiring cubic area for housing. To make a competent service purchasable for the average person, centralization and quantity production are necessary.

The hospital is undergoing a rapid change: the original purpose was to render therapeutic service, but now we have added to this a diagnostic service as well. This evolution is proper and will become more apparent and needful as time goes on.

Institutional medicine will be the final solution for the present chaotic and uneconomic situation. We must sense this situation and help solve it or lay people will do it for us. I firmly believe that physicians are well able to handle their own affairs.

It seems that we will have variants which will tend to adapt themselves to certain environments and localities. There will be three principal classes: (1) institutions supported by taxation, (2) institutions supported by private endowments, (3) those owned and directed by physicians or physicians and laymen.

Institutions will vary in the quality of performance. Large cities with tremendous wealth will be able to have keystone institutions, with the most approved housing and apparatus and a personnel of supermen; they will be able to render the finest service. Naturally, they

will be the pace-makers, and as we are living in the most highly competitive era, the old axiom of survival of the fittest will still prevail for the best interests of all concerned.

Many abuses are practiced and, sadly, the roentgenologist, who has fitted himself, medically and specially, is not accorded the recognition that he merits and justly craves.

It is true that the x-ray apparatus is an instrument of precision and lends itself admirably to greater efficiency. Of course the novice knows little or nothing about its proper use. The general diagnostician pretends to know something about it and really, he becomes more efficient with the apparatus than without it. The specialist naturally becomes very proficient.

Many hospitals engage a radiologist for a low compensation and use his efforts as a source of revenue. This is hardly fair and the abuse is lamentable. However, it is rapidly becoming extinct because the fact is recognized that it is just as impossible to get a highly competent radiologist for little compensation as it would be to get a highly competent surgeon for little compensation. You can buy service, but you cannot buy brains. In other words, an inferior institution, with an inferior service, with inferior compensation, is going to handle the inferior individual of low mentality and low financial depletion.

We have a division of labor. We have the development of the technician. It has been mentioned that we are occasionally considered glorified technicians. I do not think we have to worry about that. Ultimately, the problem will solve itself, in a measure by continual conflicts or, better still, by courtesy and performance. But, we do not have to consider ourselves inferior because we have technicians.

In reality, the technician occupies the same relationship to the radiologist that the surgical nurse bears to the surgeon, or the obstetrical nurse bears to the obstetrician.

I am sure that we all know of instances in which certain obstetrical nurses would be

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better able to deliver a baby than some obstetricians, and quite a number of surgical nurses would be better able to do certain laparotomies than some surgeons. However, as a common practice it would not be condoned and rightly so. The pernicious practice of sending patients to lay persons for radiological service is reprehensible and subversive to the best interests of the patient, and should be discouraged and discontinued.

I think we have very many hopeful signs. I am not quite so despondent. Radiologists are getting a lot of recognition here and there. We were fortunate as medical men in getting a section in the American Medical Association which we all sought for many years, which immediately gave us medical recognition. As

one looks over the list I have here, compiled by the American Medical Association (it is under the caption of Hospitals Approved for Residencies in Specialties), it is interesting to note that we have residencies in universities. I mean radiological residencies in universities, in municipal institutions, city, municipal, state and national in character, then we have the private hospitals such as the Metropolitan Insurance Company, various denominational hospitals and teaching schools and lastly, many private institutions, for instance, the Ford Hospital. All of these, if you look over this list, are high class institutions. I think from the very fact that they sense the situation properly, the final analysis will be made in conformity with the high ideals that radiologists have striven to attain.



# REDUCTION OF SIMPLE FRACTURES OF THE EXTREMITIES UNDER LOCAL ANESTHESIA\*

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CHICAGO, ILL.

THE occasion frequently arises when it is considered hazardous to administer a general anesthetic for the anesthesia was that by Conway<sup>1</sup> in 1885. He reported 3 cases of Colles' fracture and one of posterior dislocation of both bones



FIG. 1. Colles' fracture before reduction.



FIG. 2. Colles' fracture after reduction, using 5 c.c of 1 per cent novocaine solution.

reduction of a simple fracture of an extremity. Several such conditions come readily to mind: senility, advanced cardiac and renal disease, hypertension, and pulmonary lesions. With the great increase in motor accidents, one not infrequently encounters concomitant fracture of the skull and one of the extremities, for the reduction of which general anesthesia is contraindicated. It is in such situations that local infiltration anesthesia is of value.

It is a curious thing that a procedure which originated in America should have been developed to such a high degree abroad. It is a matter of record that the first report dealing with reduction of fractures of the extremities with local

at the elbow satisfactorily reduced under local anesthesia. Reclus<sup>2</sup> in 1903 made use of the method to transport in comfort a patient with a fractured femur, and found that thirty minutes later the anesthesia was sufficient to permit reduction of the fracture. Sporadic but significant reports subsequently appeared, indicating the value of the method (Lerda, Quenu, Dollinger, Braun, Cumston, Fulton, Hagenbach, Frostell, Cohen, Rice<sup>1-12</sup>). It is only within the past few years that the method has come to be used to any extent.

The advantages of local anesthesia are obvious. In addition to its value where general anesthesia is contraindicated, it may be advantageously used for other

\* From the Surgical Service of Dr. H. M. Richter. Submitted for publication March 27, 1930.

purposes. For example, a fracture may be locally anesthetized and the patient then moved to the fluoroscopic room where

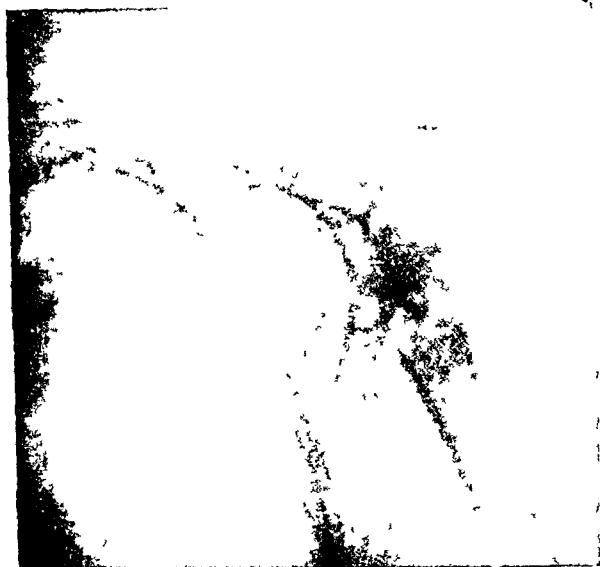


FIG. 3. Fracture of surgical neck of humerus before reduction.

reduction may be accomplished leisurely and without the danger associated with the use of inhalation anesthetics. Again,



FIG. 4. Fracture of surgical neck of humerus after reduction, using 15 c.c. of 1 per cent novocaine solution.

should the reduction not be satisfactory, the extremity may subsequently be re-manipulated with local anesthesia until proper reduction is accomplished.

The contraindications to its use are compound fractures, infected or traumatized skin, and infection elsewhere in the extremity.

Theoretically, there exists the danger of introducing infection from without. Practically, however, this is a negligible factor.



FIG. 5. Fracture of femoral neck before reduction.

No cases have been recorded where infection followed local infiltration anesthesia, and with scrupulous care it may be avoided.

The method consists of the injection of the local anesthetic directly into the site of



FIG. 6. Fracture of femoral neck after reduction, using 15 c.c. of 1 per cent novocaine solution.

fracture. We have been using a 1 per cent solution of novocaine with adrenalin (1 minim to the ounce). Under sterile pre-



cautions, a small wheal is made in the skin, and with another longer needle the solution is injected between and around the fragments. One knows when the fractured area is reached by observing the washed out, faded blood that wells up in the syringe and which is readily distinguished from the blood that is drawn up in the syringe if a blood vessel is punctured. Five to 60 or 70 c.c. may be injected depending on the type of fracture and the size and condition of the patient. We have found small amounts quite satisfactory. Anesthesia is usually complete in from ten to thirty minutes. It is astonishing to see the remarkable change produced by the local anesthesia: patients who a short time before would not even allow one to touch the affected extremity soon permit every kind of manipulation, without uttering a sound.

The following cases are illustrative:

CASE I. Mrs. F. L., aged seventy-five, was admitted to the hospital with a fracture of the surgical neck of the left humerus. Satisfactory and painless reduction was accomplished with 15 c.c. of novocaine (1 per cent).

CASE II. Mrs. H. K. aged ninety-three, was admitted with a fracture of the surgical neck of the left humerus. In this case also, the injection of 15 c.c. of solution sufficed to permit manipulation and reduction of the fracture.

CASE III. Mrs. S., aged sixty-three, a diabetic with a systolic blood pressure over 200 sustained a fracture of the surgical neck of the left humerus. Reduction was easily accomplished after the injection of 15 c.c. of novocaine.

CASE IV. Mrs. I. G., aged fifty-eight, sustained an intertrochanteric fracture of the left femur. An almost perfect reduction followed the injection of 15 c.c. of novocaine.

CASE V. Mrs. A. S., aged fifty, was admitted with a Colles' fracture (left). The fragments were satisfactorily apposed after the injection of 5 c.c. of solution.

CASE VI. Mrs. L., aged sixty-five, sustained a right Colles' fracture, which was satisfactorily reduced with 5 c.c. of novocaine.

#### SUMMARY

Attention is directed to the value of local infiltration anesthesia, as a simple, safe, practical procedure in the reduction of simple fractures of the extremities.

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# HERNIA OF THE SMALL INTESTINES

## INTO THE LESSER PERITONEAL CAVITY

### REPORT OF A CASE\*

BYRON H. JACKSON, M.D.

SCRANTON, PA.

AT necropsy and at operation the small bowels have occasionally been found in the lesser peritoneal cavity, condition. Lombard<sup>1</sup> in 1923 reported 29 cases, in 11 of which there were digestive disturbances of varying degrees. Case



FIG. 1. Shows stomach ten minutes after opaque meal. Notice at this time small bowel is shown only on left side.



FIG. 2. Three hours after ingestion, stomach nearly empty. All small bowels are on left side.

having slipped through the foramen of Winslow. This statement may be verified by turning to the anatomy of the peritoneal cavities, in which the foramen of Winslow is described. The great rarity of this hernia is due to the protected position of the foramen and the overlying liver. Pfanner<sup>1</sup> and Stauning in 1921 made a correct roentgenological diagnosis of this

<sup>1</sup> Quoted from CASE and UPSON, *J. A. M. A.*, 87: 891-897, 1926.

and Upson,<sup>1</sup> in 1926, gave the roentgenological aspects of various types of internal hernias, among which was that of the small bowel into the lesser peritoneal cavity. Since hearing this latter paper, the author of this report has been on the lookout for these various conditions, and his vigilance has been rewarded by finding, during a routine hospital examination, the following case of hernia of the small bowel into the lesser peritoneal cavity.

\* Submitted for publication April 18, 1930.

## CASE REPORT

A. W. B., a well developed, healthy appearing male, age forty-eight, 5 ft. 7 in. in height;

*X-ray Findings:* Stomach and duodenal bulb apparently normal. There is hyperperistalsis. Figure 1 shows the stomach ten minutes

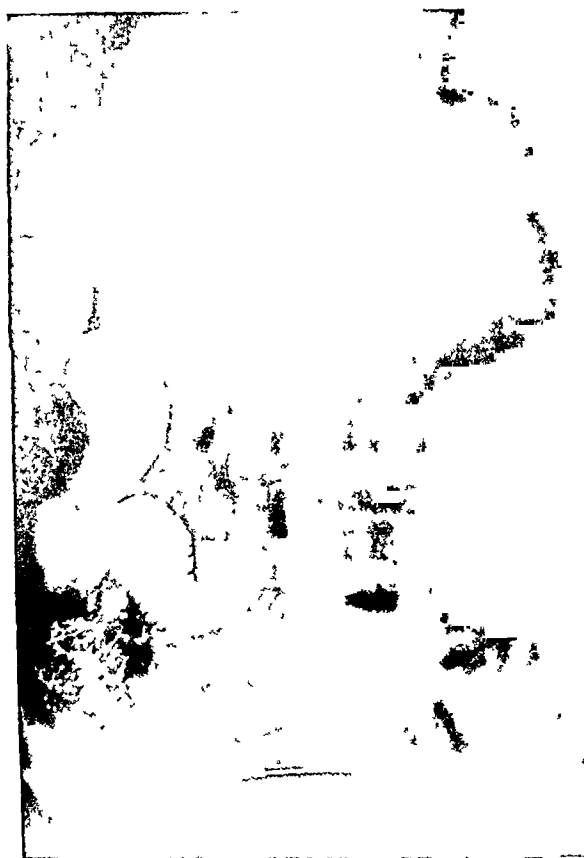


FIG. 3. Four hours after ingestion, slight residue in stomach, small bowel still on left. Note slight dilatation of small bowel.



FIG. 4. Five-hour film, same condition.

occupation, insurance salesman. Chief complaint indigestion, with intermittent pain in the upper abdomen. Has been having frequent attacks of pain in the upper abdomen over a period of fifteen or twenty years. Pain is sharp at times, of a colicky character; at other times it is simply a distressed feeling. Pain comes on one to two hours after meals, and at night between twelve and one o'clock. Heartburn at times. Relief has been obtained by flexing right leg on abdomen and bending over. Hot water and soda sometimes give relief. Laxative occasionally relieves. Pain aggravated by indiscretions of diet, acid foods, etc. Short periods of complete relief were experienced, and then long periods of distress. Vomiting an occasional symptom. No blood in vomitus or stools; no loss of weight. Palpation of the abdomen elicits slight tenderness in the epigastrium. No rigidity.

after opaque meal. Notice at this time the small bowel is shown only on the left side. Figure 2, three hours after ingestion, shows the stomach nearly empty. All the small bowels are on the left side. Figure 3, four hours after ingestion, shows a slight residue remaining in the stomach, with the small bowel still on left. Note the slight dilatation of the small bowel. Figure 4, five-hour film, shows the same condition. In Figure 5, the six-hour film, note the opaque material in the small bowel reaching up to pass through the foramen. Figure 6, seven-hour film, shows the small bowel partially within and partially without the lesser peritoneal cavity. Note the angulation of the ileum as it passes through the foramen. In this roentgenogram the cecum is already filling.

At operation the small bowel was found in the larger peritoneal cavity. The foramen of Winslow admitted three fingers. The foramen

was closed by suturing the layers of the peritoneum. One year after operation, roentgenograms of the stomach and small bowel were

well for two and one-half years, and has had no recurrence of symptoms.

The author is indebted to Dr. Carl Hosier



FIG. 5. Six-hour film. Note the opaque material in the small bowel reaching up to pass through foramen.



FIG. 6. Seven-hour film. Small bowel partially within and partially without the lesser peritoneal cavity. Note angulation of ileum as it passes through foramen. In this picture cecum is already filling.

normal and there was no evidence of displaced small intestines. The patient has been perfectly

for the history of this case and for permission to report it.



## · CASE REPORTS ·

### CARCINOMA OF THE BLADDER

#### URETEROSIGMOIDAL IMPLANTATION, TOTAL CYSTECTOMY\*

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NEW YORK

THE SUBJECT of this presentation is a man sixty-two years old who was referred for frequency, dysuria and hematuria by his family physician on January 25, 1929. The symptoms were of three months duration and had grown progressively worse so that he was now voiding every half to one hour by day, and every twenty to thirty minutes by night. The urine was grossly bloody and contained much pus; residual, two ounces. Per rectum the prostate was symmetrically enlarged to three times the normal size. Roentgen examination of the genitourinary field showed a few phleboliths, no calculi and no evidence of metastatic lesions of the lumbar spine or pelvic bones.

Cystoscopic examination disclosed intra-urethral enlargement of the lateral lobes of the prostate. On the anterior wall of the bladder extending downward to the vesical neck and laterally along the left lateral wall to the left ureteral orifice was a papillary partly necrotic growth evidently malignant in nature. Specimens removed for histological study proved it to be a papillary carcinoma with a tendency to squamous metaplasia.

In view of the extent of the lesion, its location and nature, total cystectomy with removal of the prostate and seminal vesicles was advised. Having observed the miserable existence of patients upon whom this procedure had been carried out in one step, the ureters being brought out on the abdominal wall and tubes carried in them for the rest of the patient's invalided existence, it was deemed preferable to precede the cystectomy by the simultaneous implantation of both ureters into the sigmoid as devised by Coffey. Since the patient was spare of build, he seemed a particularly favorable subject for this procedure.

The man refused operation at this time and it was not until August 19, 1929 that he

agreed to undergo it and entered the hospital. The blood urica was 18 mg. per 100 c.c. On August 23 the intestinal tract having been prepared by catharsis and enemata, the first step was carried out. As I found it impossible to pass a sigmoidoscope more than 15 cm. the introduction of a packing into the sigmoid had to be dispensed with. Spinal anesthesia, 0.12 neocaine, was employed, supplemented later by gas oxygen and ether. A liberal median infraumbilical laparotomy was performed. The ureters were exposed by incising the posterior parietal peritoneum over them. They were both dilated, measuring fully a centimeter in diameter, thin-walled and tortuous. After being traced downward almost to their vesical insertion, they were divided as low down as possible, the vesical ends being ligated with chromic catgut. The upper ends were slit for about 2 cm. and No. 12 catheters introduced toward the kidneys for a distance of about 12 cm. At this point the slit ureters were secured to small rubber cuffs with which the catheters were armed. The typical submucosal implantation described by Coffey was now carried out. The free ends of the catheters were pushed downward through a small mucosal incision until an assistant could withdraw them from the rectum. Traction was then exerted upon the catheters until the rubber cuffs had passed into the lumen of the bowel. The ureters were then buried in the sigmoidal wall by the necessary chromic catgut sutures to approximate the incised serous, muscular and submucosal coats. A Lembert linen stitch then completed the anastomosis.

The ureteral beds were then closed with fine catgut and as the bowel was approached the sites of implantation were carefully extraperitonealized. The abdomen was closed in layers without drainage. A slight technical error was

\* From the Urological Service of the Brownsville and East New York Hospital. Read before Section of Genito-Urinary Surgery, N. Y. Academy of Medicine, October 16, 1929.

made in that the right ureter was implanted lower down than the left; but this did not inconvenience me to any extent.

The postoperative course of the patient was characterized for five days by extreme abdominal distention for which at first we could employ only turpentine stupes. On the seventh day calomel and a saline produced good evacuation and complete relief. The ureteral catheters drained copiously and without interruption. The specimens showed from the very first some leucocytes on both sides.

To prevent incrustation, daily instillation with acriflavine was employed. On the tenth day the catheters came away spontaneously; very small sloughs were adherent to the rubber cuffs. I present the catheters for your inspection. On the tenth day the temperature rose to 101° and there was considerable suprapubic pain and tenderness. A catheter introduced into the bladder yielded four ounces of thick foul pus and blood. Thereafter the bladder was emptied and irrigated daily until clear. This procedure eliminated the fever and local symptoms. On the twelfth day, the wound having healed by primary union, the patient was allowed out of bed. He had complete control of the rectum, emptying it of urine and feces five or six times a day.

On September 9, 1929, seventeen days after the first step, the cystectomy was performed. The bladder was thoroughly irrigated and emptied. Spinal anesthesia was again administered. The original incision was reopened down to the bladder and peritoneum. The rectus muscles were partly cut across near the symphysis to permit of better exposure. With considerable difficulty a plane of cleavage was found between the bladder and the peritoneum laterally. When we attempted to isolate and free the fundus, the peritoneal cavity was entered and the sigmoid flexure was found adherent to the peritoneum covering the posterior wall of the bladder. By careful sharp and blunt dissection the separation of the peritoneum from the bladder was accomplished down to the region of the prostate and vesicles. The bladder was now mobilized by dividing the lateral ligaments between clamps as far out as possible. The vasa deferentia were ligated and divided and the seminal vesicles exposed. The fascia of Denonvilliers was incised and the prostate freed bluntly, posteriorly and laterally. By dividing the puboprostatic ligaments, I freed the entire mass to be removed,

except for its attachment to the membranous urethra. This attachment was severed with a curved scissors and the specimen removed in

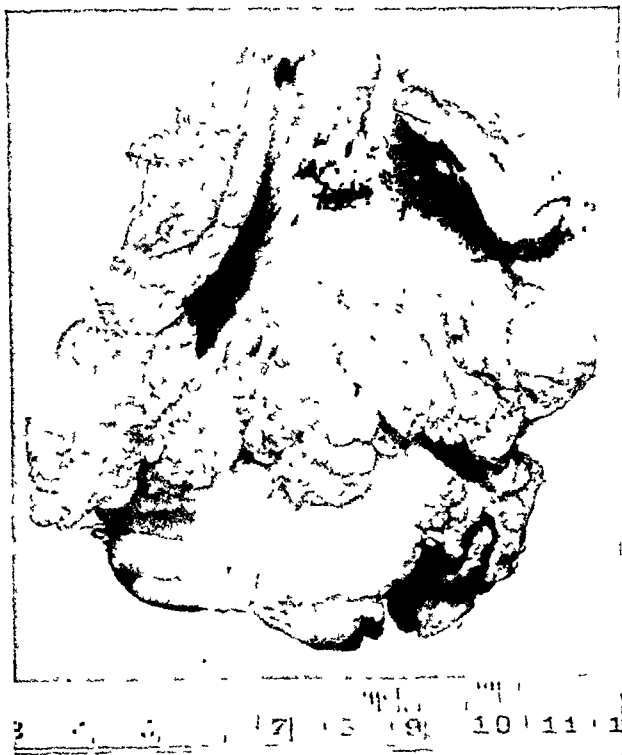


FIG. 1. Bladder, prostate and seminal vesicles removed as a unit. Specimen opened along midline anteriorly. Large papillary carcinoma infiltrating muscularis, involving trigone and vesicle neck. Hypertrophied bladder due to obstruction of the latter.

one piece—bladder, prostate and seminal vesicles. Considerable venous bleeding occurred from the divided urethra but was controlled by packing and the pressure of a Deaver retractor. After applying hemostatic sutures, we removed the clamps on the lateral ligaments.

The peritoneal rent was now carefully repaired. The huge cavity left by the radical resection was drained with a Mickulicz tampon of rubber dam and gauze. This was lead out above the symphysis and the rest of the wound closed. A rectal tube was inserted.

The patient's convalescence was remarkably smooth. There was not the least interruption in the renal function, the bowel emptying itself at first through the rectal tube, then naturally. On the fourth day the packings were removed and a tube inserted. There was a profuse discharge of thin purulent foul fluid which strongly suggested urinary leakage. Methylene blue given by mouth appeared in both the drainage and the rectal discharges. The urea content of fluid from the wound was

0.6 per cent. Indigo-carmin administered intravenously subsequently failed to appear in it, although promptly appearing from the rectum. With discharge of several sloughs the drainage from the wound became much less. It is possible that a pin point opening in the rectum was made in dissecting out the prostate. No fecal matter ever came through it and the urea content may have been due to the pus alone. There is still some thin serous odorless discharge; but I attribute this to the large raw surfaces which still remain unobliterated.

The specimen consists of the bladder, prostate and seminal vesicles removed as a unit. It has been opened in the mid-line anteriorly. (Fig. 1.) The bladder wall is markedly hypertrophied. A large sessile papillary growth involves the left ureteral orifice, the paratrifurcal region, the left lateral wall and the anterior wall of the bladder. Only the right half of the trigone is free. Superiorly, the growth extends about halfway to the apex of the bladder on the left side. Inferiorly, it extends well down to the bladder neck. On section the growth is found to be a papillary carcinoma with tendency to squamous metaplasia. It shows invasion of the bladder wall.

#### DISCUSSION

DR. B. S. BARRINGER: I have never been able to admire this operation but I cannot but admire Dr. Aschner's admirable performance of it. It is a beautiful technic, and that is what lures us on; and when you do what he has done you have accomplished a beautiful technic. There is no need of my going further, but I believe it will never be a popular operation; the mortality is high. I believe about 50 per cent.

I would like to ask Dr. Aschner how much induration of the bladder there was. Of course when we saw the picture it had infiltrated the bladder wall; but that was not a great deal. It struck me that the case might have been treated with radium with just as much chance of cure and with a 3 or 4 per cent mortality.

Dr. Coffey, when I was in Boston, radiated the tumors very severely, and before the ultimate effect of the radiation was attained, i.e. in four to six weeks, he took the tumor out. That was a very interesting way to do. He evidently had opened the bladder and radiated the tumors.

DR. ASCHNER, *closing*: Dr. Barringer says the mortality of this operation is about 50 per cent; but that is based on statistics of ureteral implantation going back for many years when the technic was not the same. Catheters were not used and rarely were both ureters transplanted at one time. In 1923, Fedoroff of Petrograd, however, reported five cases of bilateral transplantation only one of which was lost. Of the four in which the cystectomy was carried out, one remained well without recurrence six years after operation. Lower reported two successful cases in which the ureters were transplanted separately, the cystectomy being performed as the third step.

The risk of mortality in the two-stage radical operation is not from the cystectomy, but from the ureteral transplantation. Under modern conditions and technic, I believe this mortality is between 10 and 15 per cent. The mortality of the one-stage operation of cystectomy bringing the ureters out upon the skin, is at least equally high. The incidence, moreover, of pyelonephritis, calculus, stricture of the ureter, etc., after such operation, together with the discomforts and the amount of care necessary, make preferable the procedure used in the patient presented tonight.

I have employed all the means, both surgical methods and physical agents, in vogue, for the treatment of malignant vesical tumors; but this man has had a smoother, more comfortable convalescence than those upon whom the less radical procedures have been practiced. While nothing may be said as to the permanence of the result, I feel that certain types of bladder carcinoma can be treated rationally only this way.



# FOREIGN BODIES IN OS CALCIS\*

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FROM time to time we read in the lay press of the migration of a foreign body, such as a needle, throughout the human body. This is a report of a case of a piece of nail piercing the os calcis in childhood, becoming firmly surrounded by solid bone and giving no symptoms for twelve years.

## CASE HISTORY

While romping on the beach, a child, twelve years old, cut his foot. It bled a little and the foot was examined by a doctor, who said it was a small punctured wound. He treated it aseptically and the wound healed in a few days. The boy thought no more about it until years later when he commenced to have a dull aching pain in the heel. He sought medical advice and the roentgen ray as here shown revealed the cause of the trouble.

Examination showed a well-developed man of twenty-four years. No evidence of injury was found on the foot and tenderness was elicited on pressure. I advised an operation for removal of the foreign body and he was admitted to the hospital.

*Operation:* I was somewhat at a loss as to the method of approach as there seemed to be at least a half inch of solid bone covering the nail and I did not like the idea of ruthlessly chiselling away bone to reach it. I solved the difficulty by using a trephine and took out a plug of bone from the outer side of the os calcis, at the site of the nail shadow in the roentgen ray. At the depth of  $\frac{3}{4}$  inch I struck the nail. I removed the plug of bone, placing

it in warm saline. I then, with considerable difficulty, extricated the piece of nail through the trephine opening and curetted away a



FIG. 1. Lateral view of foot showing foreign body within os calcis completely surrounded by solid bone.

little rusty bone. There was no sign of any infection and I irrigated the cavity with saline and replaced the plug of bone which healed perfectly. The result of the operation was a happy one. The patient left the hospital in a few days, walked in a slipper in two weeks and resumed his work in one month. The foreign body proved to be a piece of nail with the head and point broken off. It measured  $\frac{7}{8}$  in. long,  $\frac{1}{8}$  in. wide, and  $\frac{1}{16}$  inch thick.

\* Submitted for publication October 17, 1929.





## RESECTION & ANASTOMOSIS OF THE IMPERVIOUS URETHRA\*

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IN MY clinic at the Cambridge-Maryland Hospital I am constantly called upon to solve the many and varied problems in general surgery. Prompted by Dr. H. H. Young's article,<sup>1</sup> on the treatment of complete rupture of the posterior arethra, I submit a complete report of three patients with lesions in the bulbous urethra anterior to the triangular ligament, two of complete rupture from a fall astride some object, one recent, and the other four and one-half months old and after previous operation. The third, similarly located and impermeable, was the sequel to an old gonorrheal infection and resistant to previous attempts at dilatation.

The lesions found in rupture of the urethra vary from slight lacerations all the way to a complete division, complicated at times with an extensive fracture of the pelvis with urinary or fecal extravasation. Extreme cases are seen following crushing injuries rather than a fall as in two of my patients. In view of the importance of the departure from the routine methods, I shall report them separately and in detail.

CASE I. White, aged thirty-eight, married; occupation, railroad fireman, on May 4, 1926 slipped into the water tank of his tender and fell several feet on to a submerged pipe, sustaining a severe and painful perineal injury with immediate severe pain, inability to void and bleeding from the urethra. Seen two hours later; excellent general condition, hemoglobin was 80 per cent, abdomen negative, the external genitalia not affected but a distinct bulging in the perineum. Per rectum a normal prostate was felt and definite compression of the rectum by a soft mass extending up to the base of the bladder. A catheter passed into the urethra reached the region of the membranous urethra

and evacuated a moderate amount of blood; a finger in the rectum detected the catheter free in a cavity in front.

*Diagnosis:* complete rupture of the urethra with extravasation of blood. An x-ray examination of the pelvis disclosed a transverse fracture of the right descending pubic ramus in situ.

*Operation:* A longitudinal incision in the perineum opened into a large hematoma; when this was evacuated an actively spurting artery was seen. This and all lesser bleeding points were controlled by plain catgut ligature. Investigation with a sound per urethrum revealed the bulbous urethra completely severed just in front of the membranous urethra and the triangular ligament. The posterior end could not be located in the bruised and bloody field and, as I did not feel a suprapubic retrograde catheterization advisable at the time, the skin was united loosely with catgut around a gauze drain. When the patient recovered from the anesthetic, voiding was normal through the perineal wound, no urine passing from the meatus; this continued until June 9, 1926, when healing was complete except up to a small urinary sinus. On this date the second operation was done to anastomose the severed urethra. A rubber catheter was passed into the bladder through the perineal sinus and the healed incision reopened and a metal sound passed through the meatus which reached to within  $2\frac{1}{2}$  cm. from the posterior urethral opening. The completely closed anterior end was opened on the tip of a sound and freed with sufficient paraurethral tissue to assure circulation and thoroughly mobilized. The posterior segment was likewise mobilized. A No. 24 F. soft rubber catheter was introduced anteriorly to the perineal opening, when the original catheter was removed, and passed on into the bladder. Around the catheter a transverse end-to-end anastomosis was done with interrupted No. 0 twenty-day catgut sutures. Additional sutures of plain fine catgut were placed through the fibrinous and muscle tissue to reinforce the

<sup>1</sup>Young, H. H. *Trans. Am. Assoc. G.-U. Surg.*, 21: 1928.

\* From the Howard A. Kelly Hospital. Submitted for publication December 3, 1929.

first line of closure. A small gauze drain was placed to the line of anastomosis, and the closure completed with plain catgut. The convalescence was normal; the catheter, remaining in place without any leakage, was removed on the tenth day. Voiding was normal and in two weeks the incision was healed. The fracture gave no trouble. Dilatations were carried out June 23, July 2 and 9, September 16, December 1 and January 24, 1927. July, 1927, sounds revealed no stricture and erections were normal. He has remained free from any sequelae.

**CASE II.** White, aged sixty, married. Occupation: carpenter. While working September 1, 1926 fell astride a saw horse and sustained a severe blow on the perineum. An operation done the same day for a ruptured urethra through a suprapubic and an inverted U incision in the perineum was unsuccessful, and the urine drained suprapubically and through two perineal fistulae. Perineal abscesses developed from time to time, either rupturing spontaneously, or calling for an incision. There was always a discharge of pus demanding a pad. For a short time a small amount of urine passed the meatus, but none for two months up to the time I first saw him on January 19, 1927, when he came through the advice of the first patient. Examination negative, outside the local condition. The healed suprapubic scar drained a little urine through its lower angle. There were two small discharging sinuses in the perineum. He voided urine through both voluntarily, and the entire region was densely scarred. External genitalia were normal, prostate was diffusely hypertrophied, without symptoms. Rectal examination otherwise negative. Filiform bougies introduced into the perineal sinuses failed to enter the bladder and a sound passed through the meatus only reached the membranous urethra, the tip just being palpable per rectum through the dense scar tissue.

*Diagnosis:* complete traumatic rupture of the bulbous urethra with marked cicatrix and water-pot perineum.

*Operation* on date of examination under ether anesthesia. The anterior urethra and both perineal sinuses were injected with methylene blue. A metal sound was passed through the anterior urethra to the point of obstruction and a second through the suprapubic fistula

into the bladder out through the prostatic urethra, the tip extending through the membranous urethra. A median incision was made in the perineum and both sinuses dissected out under the guidance of the methylene blue, as they led by separate tracks to the tip of the sound in the membranous urethra just outside of the triangular ligament. A large amount of scar tissue was dissected away, clearly exposing both sounds and completely destroying a gap of 3 cm. of the urethra. The severed ends were freely mobilized and all fibrous thickening removed out into the normal surroundings. A No. 24 F. soft rubber catheter was passed into the bladder through the posterior segment as the sound was removed and the distal end threaded on to the tip of the anterior sound and withdrawn out through the anterior urethra. An end-to-end transverse anastomosis was done around the catheter with interrupted No. 1 twenty-day catgut sutures, reinforced by additional sutures of plain catgut. The skin was loosely united with black silk and a plain gauze drain left inserted at the posterior angle. Convalescence normal, healing without leakage or extravasation. The suprapubic incision healed spontaneously. The catheter was removed on the twelfth day and sounds to No. 20 F. passed on the fourteenth day. When the patient was seen in two months voiding was normal and I was able to dilate to a No. 28 F. He was well in July, 1927 when sounds were passed; a further recent report states that he is well.

**CASE III.** Differing from the preceding was the case of a patient with an impermeable stricture from an old gonorrheal infection. As the operative procedure was somewhat similar, I include it here. The patient, white, aged fifty-one, married, was by occupation a water-man. As a youth he contracted gonorrhea, and for twenty years had attacks of dysuria lasting several weeks; at no time was he able to void normally. This gradually increased and no prolonged relief was experienced from dilatations. In March, 1929 an operation was done for hemorrhoids and the stricture unsuccessfully dilated and since then, particularly for the past three weeks, has been in constant pain, emptying the bladder most of the past week involuntarily by dribbling. Attempts to catheterize have failed. I first saw him September 12, 1929, in great pain,

with the bladder extending halfway to the umbilicus with an involuntary dribbling of ammoniacal urine. A sound refused to go beyond the region of the triangular ligament; the obstruction was also impermeable to filiform bougies. The prostate was normal and above it lay the tense, distended bladder. Rather than do a cystostomy I decided to resect the stricture from below. Methylene blue was injected anteriorly and milked towards the bladder. A median perineal incision was made and the tissues cut down to a sound passed to the obstruction. The urethra was dissected free over the sound and opened on its tip. It was markedly thickened and the lumen tortuous and threadlike, a fact clearly demonstrated by the methylene blue. The stained tract was followed up to the normal urethra just in front of the triangular ligament. The entire segment of the urethra (2.5 cm.) was excised with all enveloping scar tissues. A No. 22 F. soft rubber catheter was then introduced into the bladder, evacuating 1200 c.c. of foul urine. The distal end of the catheter was then threaded over the tip of the sound and drawn out through the meatus. With moderate tension the ends were joined transversely about the catheter with interrupted No. 1 twenty-day catgut sutures, reinforced by plain catgut sutures, and the skin closed with interrupted sutures, leaving a small cigarette drain up to the anastomosis. Convalescence normal; no leakage or extravasation of urine until the catheter was removed on the seventh day as the patient began voiding around it, with some leakage through the perineum. Voiding continued normal and the perineal leakage grew less and ceased at the end of the fourth week when the healing was complete. At the end of the second week I passed a small sound into the bladder. A No. 28 F. easily passed in the fifth week and voiding was normal. He was seen

and dilated October 30th; subsequent dilatations will be continued.

CASE IV. A fourth patient was operated upon at the Church Home and Infirmary, Baltimore, in 1915. Since a portion of the history is lost, a detailed report cannot be given. An employee of a timber company in North Carolina fell while at work, straddling an object and sustained a severe blow on the perineum, followed by bleeding from the urethra. He remained in a local hospital for three weeks with a retention catheter; following its removal he found voiding difficult at first, gradually growing worse. Attempts to dilate gave no definite relief. When I saw him approximately six months after the injury, I found the bulbous urethra markedly indurated, and a sound stopped at this point. After consultation with the late Dr. J. T. Geraghty, instead of an internal urethrotomy, an open operation was carried out as described in Case III; this was followed by complete relief. Subsequent dilatations were carried out, the patient remaining perfectly well until I lost track of him five years later.

#### CONCLUSIONS

1. Accurate knowledge of the regional anatomy is a prime requisite.
2. Preliminary injection of methylene blue is of great assistance, outlining the distorted urethra and any diverticula for the subsequent operation.
3. Sharp dissection, delicate instruments and fine sutures with careful manipulation insure the union of the approximated tissues.
4. Some follow-up dilatations of the urethra must be carried out later to obviate any stricture in the tract.



# INFLAMMATORY CARCINOMA OF THE BREAST\*

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I AM reporting these cases as, contrary to some statistics, this lesion seems to be a rather unusual one. Besides, they were seen earlier than most reported cases, which is an important factor as we must make earlier diagnoses in this group if we are to have even an early mortality of less than one 100 per cent. The cancer mortality from breast carcinomas is already very high but these cases are practically always rapidly fatal. The first patient presented a lesion which was only moderately advanced for this type but died within a few months. The next patient, a little more advanced, disappeared after I had examined her and the third case is still living but the condition is only a few months old. (Since writing this report, the third case has died of local, cerebral and massive lung metastases, six months after operation.)

CASE I. Mrs. T; English by birth; thirty-nine years old. Married for twelve years; had three children, eleven, five and three. She was stout and well-nourished which condition persisted until a very short time before her death. She was sent to me for examination of the left breast. Stated that a few weeks before she noticed that the left breast was thickened and she thought it was slightly enlarged. She felt no pain but rather a sort of burning sensation. She consulted a doctor a few days previous to my examination for the first time. Stated she nursed her first child but was unable to nurse the others.

Examination showed a rather stout woman, 5 ft. 5 in. tall; weight 180 pounds. The general physical examination showed nothing abnormal. Breasts were pendulous and large. There was a thickening of the left breast; the skin was a little edematous and pinkish, not a marked redness. There was a diffuse thickening of the whole breast tissue and a slight tenderness. The nipple was normal in appearance, but on squeezing, I found a slight serous discharge. The temperature was 99.6°F.; pulse 84. There

was no history of chills nor acute onset. From the appearance of the breast, I believed this was a mild inflammatory condition aggravated by the pendulous condition. I ordered elevation, rest in bed and hot moist applications.

One week later she reported and was much improved. The tenderness was nearly gone; the edema not so marked and the pink color almost absent. I ordered a continuation of the same treatment. At the end of another week she returned feeling less comfortable, but as she had only partially carried out my orders, I told her to continue as she had been doing: that is, elevation, heat and bed rest.

I saw her again in a few days in which time the pain and tenderness had increased and the redness and edema were more marked. I sent her to the hospital with the idea of opening a deep abscess. On cutting into the mass I found what appeared to be a definite malignancy. Therefore had sections made and did a radical removal. Enlargement of a few axillary glands was beginning. The immediate convalescence was normal; but three months later signs of lung involvement appeared and in a few weeks she was dead, of extensive metastases both local and general.

CASE II. This patient presented herself for examination a few weeks after the first one. She was forty-one years old; unmarried, rather stout and had large pendulous breasts. The history was of a thickening noticed some few weeks before and of discomfort, pain and burning for the past few weeks. The right breast was involved.

Examination showed a large, pendulous, right breast with considerable thickening. The skin was pink and slightly edematous. No retraction of the nipple and no palpable glandular enlargement. I advised deep x-ray therapy, but did not see this patient again. She had very definitely the same type of growth we found in the first instance.

CASE III. This patient came in for examination about four months ago. A large woman; fifty years old, married, but had borne

\* Read before the Pacific Coast Surgical Association, Santa Barbara, Calif., February 22-23, 1929.

no children. She first noticed thickening of the left breast two months previous. There was slight pain, burning and tenderness for only a few days. The breast appeared slightly enlarged and there was an indefinite tumor mass. The skin was slightly edematous and slightly pinkish but was not reddened. This was localized to an area 2 in. in diameter around the nipple. There was no palpable glandular enlargement. The breast was quite sensitive to the touch. This, as in the other cases, looked like a mild inflammatory process, but in the absence of history suggesting an infection, I advised a radical removal. I did this believing that this was an inflammatory carcinoma but I thought it possible that being a relatively early case, operation might offer something. I knew also that nothing else offered any relief.

She did not come in for operation till two weeks later, at which time the edema was very, very much less and had almost disappeared, the mass, however, remaining the same. I did a radical removal and found the same pathological picture that I found in the first case, a rapidly-growing soft carcinoma. This case is only four months old so I cannot as yet say what the outcome will be. (I have previously given the outcome of this case.) I may add that before the operation I had her chest x-rayed and this was negative. Both cases had x-rays taken after operation.

These three cases were early examples of the typical inflammatory carcinoma in which the skin becomes red or purple, edematous and erysipeloid. This condition is present from the very beginning and is not to be confused with the same picture which may occur in the course of a more advanced carcinoma.

It is of particular interest in the first case that the redness and the edema varied over a period of three weeks and the same thing was true in the last case, the edema present on first examination being much more marked than two weeks later at the time of the operation.

Bell in 1841 in discussing breast carcinoma said: "When a purple color is on the skin over the tumor accompanied by pain, it is a very, very unpropitious beginning."

Several other observers, among them Klotz and Volkmann, have described the

same condition occurring in the lactating breast. Billroth in 1871 and Rodman in 1889 each described this lesion. Schumann reported 11 cases including one of his own and more recently Lee and Tannenbaum reported 28 cases. According to their statistics this condition occurs in 1.3 per cent of all cases of breast carcinoma. Since then Lee has collected 100 cases.

The condition is frequently very acute and does not respond in any way to the usual treatment. The initial symptoms are heaviness and burning of the breast and increase in size. The increase is ordinarily diffuse but there may be a partially defined tumor not, however, of the usual stony hardness. It has occurred most frequently in pendulous breasts and one half of the cases are nullipara.

Early in the disease there are skin changes simulating low grade inflammation. Retraction of the nipple occurs late and the nipple may become edematous. Glandular involvement appears early. Later the skin becomes deep red or reddish purple and is hard and infiltrated. This description I have taken from Lee and Tannenbaum's paper as my cases were seen early and did not show this change so markedly. The infiltration is like erysipelas and may be extensive. There may be a temperature of 100° F. blood picture shows nothing. Later in the course minute areas of ulceration occur but there is no breaking down en masse. Pulmonary metastases are rapidly progressive when they occur. The patient's general nutrition remains good until late in the disease. The inflammatory symptoms appear early and are present apparently from the very beginning. As stated before skin involvement may appear later in other breast cancers but this is not the type of case under discussion.

In a considerable series of cases the age varied from twenty-six to fifty-one, average being forty-four. Lactation has no apparent effect, being present in approximately 50 per cent of the cases. The differentiation must be made practically only from

abscess. Absence of an etiological factor, an ill-defined tumor, slight if any temperature elevation and no leucocytosis, should clear the diagnosis.

Sections of both these breasts showed a medullary carcinoma with a small amount of connective tissue stroma. I am sorry to say I did not section the skin as it is involved early and certainly would have shown invasion by carcinomatous cells, particularly in the first case. Lee has obtained cultures of streptococcus viridans from macerated tissue in one case.

#### TREATMENT

Radiation possibly offers more than anything else in the advanced cases as a palliative measure. As a matter of fact, the advanced cases do poorly under any

sort of treatment. Surgical removal has seemed to hasten the course. I would not again operate on a case as advanced as the first one. The third one seemed much earlier and I thought it possible that removal would offer more than x-ray, but the outcome proved that my judgment was wrong.

If we are to accomplish anything we will have to see these patients earlier than most of those reported. If so, it is possible that by an early diagnosis and early treatment, some may be saved.

I have avoided any reference to the use of the cautery as it seems to me that if the disease has infiltrated the tissues diffusely, it will certainly not make any difference and if it has not, removal with the knife will be sufficient.



## VAGINAL CESAREAN SECTION

### WITH CASE REPORT\*

ANTHONY WOLLNER, M.D.

THE indications for vaginal cesarean section being quite limited, suitable cases are rarely seen. Perfection of the technic and variations in the methods of abdominal section have placed the vaginal operation in the background. Since Duehrssen introduced the vaginal section into obstetrical surgery in 1896, the indications for the operation have undergone numerous changes, the low cervical and extraperitoneal modifications of abdominal cesarean section having almost entirely superseded the vaginal operation. Although the popularity of abdominal cesarean is justified, there are, nevertheless, certain cases encountered in obstetrical practice in which the vaginal section is preferable. This is well illustrated by the following case:

K. B. thirty-five years of age, white, female, came under my observation on December 13, 1928. The patient being in a semi-conscious

condition, the following history was secured from her family physician:

*Family History.* Father died at thirty-four, following a cranial operation which revealed cerebral syphilis. Family history otherwise negative.

*Past History.* No previous illnesses with the exception of anemia and nervousness at twenty-one years of age, diagnosed as chlorosis.

*Menstrual History.* Began at fourteen, six to seven-week interval, duration four to five days. Prior to each menstruation, patient had hot flushes in the head and neck; backache and cramps for the first two days of the period.

*Marital.* Married four years. Pregnancy 1924, miscarriage of six to seven-week fetus, following an accident.

*Present Illness.* The patient was first seen by her family physician in February, 1928.

*Physical Examination.* Heart normal, lungs clear, all reflexes slightly increased, slight anemia.

*Urine Analysis.* Faint trace of albumen.

*Uterus.* Anteverted, slight erosion of cervix with profuse discharge. The erosion was

\* Read before the Section on Obstetrics and Gynecology, N. Y. Academy of Medicine, November 26, 1929.

treated with silver nitrate applications, with marked benefit. Adnexa normal.

May 26, 1928, patient complained of nausea and vomiting in the morning during the preceding two days. Last menstrual period began April 28.

*Examination.* Bluish discoloration of the cervix, uterus slightly enlarged and soft. Left ovary enlarged to size of a walnut. This was thought to be the corpus luteum gravidarum. On subsequent examination the left ovary was found the same size, and the uterus enlarged progressively as in normal pregnancy.

There was no change in the patient's condition until November 7: Blood Pressure 140/80; fundus one finger above umbilicus; fetal heart sounds loud. Urine analysis as on previous examination.

November 14, patient complained of pain in the lower abdomen and right upper quadrant. Rest in bed and a restricted diet were prescribed. The pains disappeared after six days.

November 23, pains of same character recurred, with impairment of vision. Patient complained of seeing small black spots. B. P. 180/100. Fetal heart sounds of good quality. A more strict diet and a belladonna preparation were prescribed.

November 30, patient complained of uterine cramps and slight bleeding from the vagina. Size of uterus that of a six to seventh-month pregnancy. Urine analysis albumen 0.27 per cent; moderate number of hyaline and few granular casts.

December 1, patient restless, complained of insomnia, severe headaches, and apprehensive. Blood chemistry; non-protein nitrogen 67.57 per cent. Increased impairment of vision. Cessation of bleeding on the following day.

December 6, ascites. B. P. 210/110; pulse 100, increased impairment of vision. Patient was removed to the hospital. Eye ground examination; small effusions and papillary edema, diagnosed as albuminuric retinitis. Consultants advised waiting for spontaneous delivery and the patient was discharged.

December 8, no fetal heart sounds heard, patient no longer felt life; restlessness and headaches more marked; patient could not distinguish the number of fingers at a distance of ten feet. B. P. 190/100, pulse 105.

December 13, attack of dyspnea, chill, short period of unconsciousness. I was then called in consultation.

The clinical picture was that of a grave

toxemia of pregnancy and immediate interruption of the pregnancy was indicated. Because of the intensity of the toxemia, the method of interruption affording the quickest and most painless termination was selected. Cervical dilatation and the introduction of a bag were considered inadvisable for the following reasons: (1) because the rigid soft parts of an elderly primipara might not dilate sufficiently, and (2), because this method would not exclude labor pains. The choice for a rapid delivery lay between the abdominal and vaginal section. Because of the fact that the fetus had been dead for the last ten days, abdominal section was not justifiable, particularly since the much less dangerous procedure of vaginal section was available.

#### DESCRIPTION OF OPERATION

Usual preoperative preparation, disinfection of the vulva and vagina with green soap and douching; catheterization. Vaginal retractors are introduced and the cervix visualized; two vulsella applied at either side of the median line and the cervix drawn downward. A transverse incision is made on the anterior surface of the cervix, going through the vaginal mucous membrane. The bladder is pushed upward from the anterior cervical wall, using one finger covered with gauze for this purpose (the bladder is separated very easily from the cervix in pregnant women). The bladder is pushed upward until the uterovesical fold of peritoneum can be visualized at the upper angle of the wound. The bladder is retracted by the insertion of a narrow speculum, and in this manner the anterior wall of the cervix is exposed. Traction is made with the cervical vulsella and the anterior wall of the cervix is split with scissors in the median line up to the internal os. This brings the bag of waters into the opening (up to this point in the operative procedure there is practically no hemorrhage). When the bag of water is opened, the liquor amnii is evacuated. The size of the opening into the uterine cavity is now tested by means of the introduction of the closed fist, and determination is thereby made of the adequacy of this opening for the extraction of the fetus. The fetus being non-viable, delivery may be accomplished by means of craniotomy. After perforating the cranium a large portion of its contents is removed. At this stage of fetal development the cranial bones are soft and thin. The use of a cranioclast is contra-

indicated, and delivery is accomplished by means of version and podalic extraction. In this case version and extraction were accomplished without difficulty, and a macerated seven-month fetus delivered. The placenta and membranes were expelled by gentle expression after a ten-minute period. Previous to the versional extraction all instruments are removed from the vagina in order to gain more space and prevent injury to both the maternal tissues and the hand of the operator. Upon completion of the delivery the instruments are reapplied and the operative field inspected. In this case it was found that the incision on the anterior surface of the cervix had not been extended by tearing and the hemorrhage did not exceed that of a normal delivery. One cubic centimeter of obstetrical pituitrin is injected into the wall of the cervix before suturing. Traction is made on the vulsella in order to bring the uppermost angle of the wound into view; interrupted chronic catgut sutures are used, which extend through the muscularis but which do not include the mucosa. The uterine cavity is packed with gauze, and a strip of gauze is left in the subperitoneal wound for a twenty-four hour period. The vaginal edges are united by means of interrupted catgut sutures. The duration of the operation in this instance was thirty-five minutes.

#### POSTOPERATIVE PERIOD

The rapid recovery following operation in this case was remarkable. Ten hours postoperative the patient did not give one the impression of an operative case. There were none of the usual signs of the after effects of a laparotomy; with the exception of slight uterine contraction, the patient complained of no discomfort. The temperature rose to 100°F. on the first day; after this it remained between 98.8° and 99.4°F. The pulse rate remained unchanged and was about 100°F. as before operation. On the sixth day there was a gradual decrease of the pulse rate and this became normal on the tenth day. A considerable improvement in vision was noted as early as the first day. On the second day the patient could distinguish the fingers of a hand, and there was continuous improvement until the tenth day, when the patient was able to read. The urine which had shown a four plus albumen reaction prior to the operation was two plus on the sixth day and continued so

until the patient was discharged from the hospital. Blood pressure on the fourth day was 140/88, on the tenth day 130/86. The patient voided spontaneously from the first day. Examination on discharge revealed a normally involuted uterus and normal adnexa. Vaginal examination showed primary union of the incision and a normally shaped cervix.

In this operation I deviated in two respects from the usual technic of vaginal section. As a rule the operation is commenced with a deep episiotomy. This shortens the length of the vaginal canal, makes the cervix more accessible, and prevents the irregular tears of the vagina and perineum during the extraction of the fetus. I do not feel that the episiotomy is advisable, as there is considerable hemorrhage from the incision. This is occasionally difficult to check and consumes valuable time. In many instances there is a greater loss of blood from this procedure than from the vaginal section itself. If the section is performed in a case of prematurity or in the case of a mature but dead fetus, where the delivery can be accomplished by means of craniotomy, we do not have to anticipate injury to the vagina or perineum. In those cases in which a mature living fetus is delivered there may be a need for episiotomy, but in these cases it may be done at the time when it becomes imperative.

Another deviation from the routine procedure was the use of one anterior incision only, on the cervical wall. Duehrssen insists that two incisions be made; one anteriorly and one posteriorly. Most obstetricians familiar with the method are in accord with Duehrssen. We, however, share Bumm's opinion and find that the anterior incision, if extended, gives sufficient space for even a full-term child. The omission of the episiotomy and posterior incision of the cervix shortens and simplifies the method considerably and therefore makes the operation of greater value in toxic cases.

Vaginal cesarean section involves two important hazards which one must care-



fully avoid. One of these is injury to the bladder or ureters. This can be obviated by reaching the proper layer when making the first transverse incision; it must extend sufficiently through the vaginal mucosa. If one reaches the proper layer there is no difficulty in pushing the bladder upward by means of one gauze wrapped finger. Should there be any difficulty in locating the bladder, its lowest point may be located by means of the introduction of a metal catheter.

When the bladder has been pushed upward to the required extent, one must be sure it is well retracted so that there is no danger of injury when the cervical incision is made. Anyone experienced in pelvic surgery should have no difficulty in avoiding injury to the bladder. Before placing the cervical sutures the bladder should be catheterized to make certain that it is undamaged.

An additional point that must be borne in mind is that the cervical incision may extend by tearing during the delivery of the fetus. Should this tear directly upwards into the corpus of the uterus, it may open the peritoneal cavity; but this is not a serious complication if it is repaired promptly. On the other hand, should this tear extend in a lateral direction toward the parametrium, there is danger of rupturing the uterine artery or vein, with profuse hemorrhage. Such an accident may necessitate the ultimate removal of the uterus. However, if the original incision of the cervix is absolutely in the median line and of sufficient extent, there is no likelihood of a lateral tear. One must remember before making the cervical incision that the cervix may be rotated to one side, and careful examination must be made therefore before the incision. There is no hemorrhage from the cervical incision if done correctly and if traction is made on the vulsella. If the cervical incision is made up to the peritoneal fold there is ample space for the passage of a mature fetus, as this incision is as extensive as that of a low cervical cesarean section.

Difficulty may be experienced in attempting to deliver a mature fetus through the unprepared vagina. If forceps is applied, or if version is done, and the extraction of the aftercoming head is done too rapidly, laceration is more likely.

In the delivery of a mature living fetus one may be faced with a situation where there is a conflict between the interests of the mother and that of the child. If one is too cautious in the delivery of the fetus it prolongs the operation and imperils the life of the child. On the other hand, if a rapid delivery is accomplished, the upper portion of the vagina can hardly escape grave injury. This presents a paradoxical situation for the obstetrician, and it is for this reason that we do not advise vaginal cesarean section in cases where one is dealing with a mature living child. In such a case, the apparent advantage of vaginal section is outweighed by the resistance offered by the unprepared vagina during delivery; in the case of a mature living child preference should always be given to the abdominal operation.

In those cases where the fetus is premature or is mature but dead, the above mentioned dangers are of less importance, and in this group the vaginal cesarean section has decided advantages. The convalescence following a vaginal section is more rapid and the usual unpleasant symptoms following laparotomy are avoided. The patient regains her strength and resistance in an amazingly short post-operative period, which is of special significance in cases of toxemia. The vaginal cesarean section obviates exposure of the peritoneum and the duration of the operation is shorter. There is no record in the literature of any complication in subsequent pregnancy or labor because of the cervical scar. Another advantage of this operation is the avoidance of peritoneal infection as the entire procedure is extraperitoneal.

#### CONCLUSION

In cases where one is dealing with unpre-

pared softs parts and where a rapid painless delivery is essential, one has the choice of either abdominal or vaginal section. The decision should depend entirely on the condition and age of the fetus. If the fetus is mature and alive, abdominal cesarean section is the method of choice and gives more satisfactory

results. If, on the other hand, the fetus is premature, or is mature, but dead, the vaginal cesarean section should be performed. The indications for vaginal cesarean section are very limited; but in properly selected cases the advantages which it offers are unsurpassed by any other method.



## COSMETIC RESULT IN A CASE OF MARKED SCOLIOSIS

WITH ROTATION OF THE RIBS TREATED BY CONVEX FRAME, SPINE FUSION AND RIB RESECTION\*

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A GIRL fourteen years old was admitted to the Hospital for Joint Diseases on August 15, 1928, with the complaint of deformity of the back of two years' duration. Examination showed a very marked right

dorso-lumbar scoliosis with marked rotation of the ribs to the right, and a collapse of the trunk, as shown in Figure 3. After being kept on a convex frame for several months, the patient was operated upon by Dr. Samuel

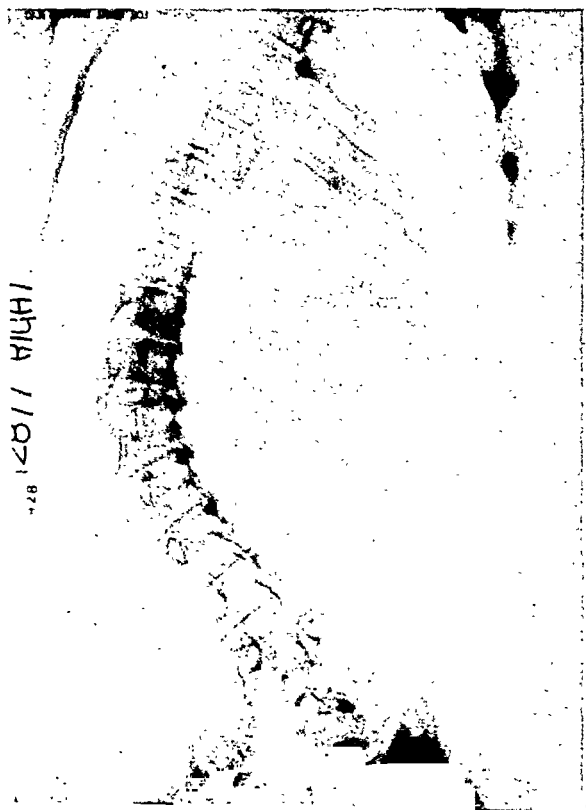


FIG. 1. Anteroposterior roentgenogram of spine before operation.



FIG. 2. Anteroposterior roentgenogram of spine eight months after spine fusion. Note improvement in curvature. The beef bone graft is beginning to be absorbed. There is considerable bony callus formation.

\* Presented before Section of Orthopedic Surgery, New York Academy of Medicine, October 19, 1929.

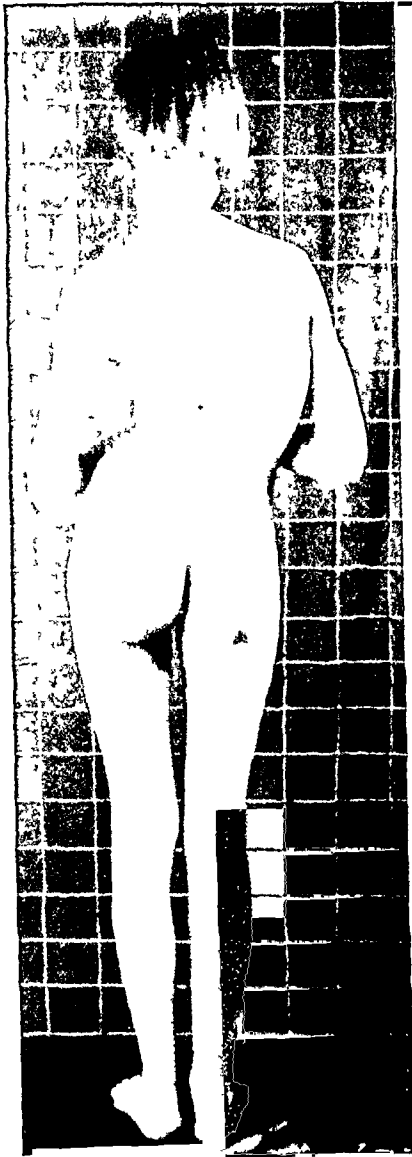


FIG. 3.



FIG. 4.



FIG. 5.

FIG. 3. Appearance of back before operation. Note sagging and shifting of trunk to right and marked rotation and prominence of ribs on right side

FIG. 4. Appearance of back after spine fusion and rib resection.

FIG. 5. Appearance of back when apparent shortening of right lower limb is compensated by an inch lift of right shoe.

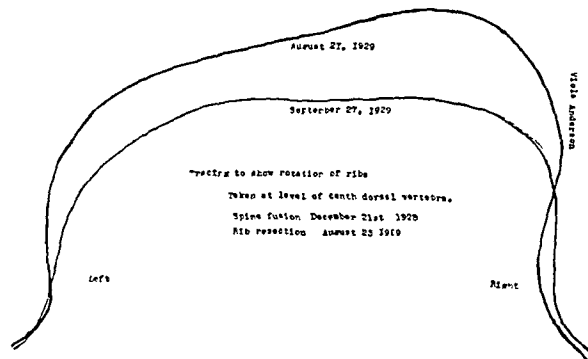


FIG. 6. Tracing of back at level of the tenth dorsal vertebra before and after rib resection to show improvement in deformity.

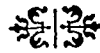
Kleinberg, who performed a spine fusion from the fifth dorsal to the second lumbar vertebra, and inserted a beef bone graft on the concave side of the curve. Ten days later the patient was replaced on a convex frame and on February 1, 1929, the child was discharged wearing a plaster of Paris jacket.

She was readmitted to the service of Dr. Kleinberg, at the Hospital for Joint Diseases on August 20, 1929, for the correction of the deformity due to the rotation of the ribs.

Examination at that time showed that the back was markedly improved, that the operated area was stiff, that the patient's posture was considerably improved, and that she was

several inches taller than on the previous admission. It was also noted that there was an apparent shortening of the right lower limb of 1 inch. On August 23, 1929, a rib resection, as advocated by Dr. Armitage Whitman, was performed by me. I removed about two and a half to three and a half inches of the sixth to the eleventh ribs inclusive. Eleven days later the patient was placed on a convex frame and four weeks thereafter she was discharged, markedly improved in appearance and in general condition.

This case was presented to demonstrate the cosmetic result obtainable by means of the convex frame treatment, spine fusion and rib resection.



## MYXOGLOBULOSIS OF THE APPENDIX\*

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RETENTION cysts of the appendix with mucous content were first described by Fraenkel in 1901 and appear in the literature under various names as hydrops of appendix, colloid or pseudomucinous cyst, myxocoele, mucocoele, mucinous cyst, pseudomyxoma, etc. They are rather rare, if a correct conclusion can be drawn from the number of cases reported. Weaver<sup>1</sup> collected 168 cases in 1928 from the literature. An uncommon variety of this condition is the myxoglobulosis (Hansemann<sup>2</sup>) or the fish egg appendix (Morrison<sup>3</sup>). Weaver found only 8 cases recorded of this type which number Hudacsek<sup>4</sup> could increase to twelve in 1929. The condition is characterized by the presence of globoid bodies of mucinous character in the cystic content resembling in their gross appearance fish eggs. These balls vary considerably in size and may reach one centimeter in diameter. They contain occasionally calcifications. They represent inspissated balls of mucoïd material around minute masses of necrotic material and are composed

of mucin and pseudomucin sometimes arranged in concentric layers. The lumen of the appendix is more or less distended and lined by a straight, sometimes stratified layer of cylindrical mucus-producing cells of goblet cell type. With the increasing pressure of the mucous content degenerative changes of the epithelial cells may occur, resulting in a self-limitation of the process. The submucosa is fibrous and contains no or very little lymphoid tissue. A mucinous imbibition of the submucosa is sometimes observed. The muscularis is usually thinned, but also hypertrophy may be seen (Hudacsek<sup>4</sup>). Stenosis of the lumen at the cecal os with continuation of the mucus production by the mucosa and with absence of an infection is regarded as the causative mechanism of this condition. The stenosis may be due to a constrictive scar formation from a preceding appendicitis (Aschoff<sup>5</sup>), or due to angulation, torsion, compression by adhesions, invagination into the cecum, foreign bodies or parasites in the lumen of the appendix. The clinical symptoms

\* Submitted for publication December 30, 1929.

produced are usually those of a chronic appendicitis. As secondary complications, we find listed, ileus, volvulus and rupture

of admission was negative with the exception of a slight tenderness and rigidity in the lower right quadrant showing no increased tender-

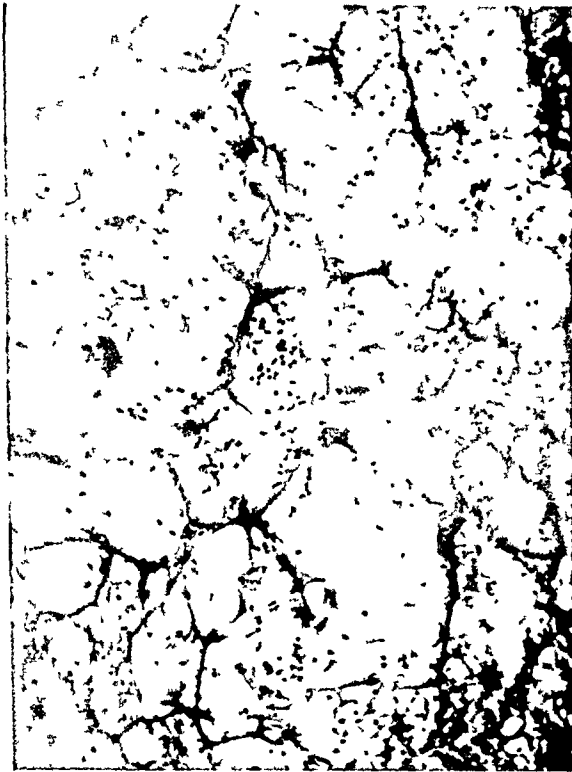


FIG. 1. Myxomatous area in submucosa.

of the appendix with subsequent pseudomyxoma peritonei (Morrison,<sup>3</sup> Wegener<sup>6</sup>), which, according to Hudacsek,<sup>4</sup> shall differ in prognostic respect from that following a ruptured ovarian cyst. While the latter is, as a rule, fatal in spite of surgical interference, the former offers a good prognosis. In Hamdi's<sup>7</sup> case only were metastases found in the liver and breast, so that Hudacsek claims they were of benign nature.

#### CASE REPORT

Mr. M. K., thirty-five years old, had for the last three years attacks of pain in the lower abdomen which were acute in onset, cramp-like in character and lasting from a few hours to a couple of days. They appeared in intervals of weeks and months and had not increased in severity. The last attack was similar in character to those previously observed, but the pain became most prominent over McBurney's point. There was no nausea or vomiting present. The physical examination at the time



FIG. 2. Papilloma with atypical epithelium and portion of mucous globule.



FIG. 3. Hyperchromatic, atypical epithelium lining portions of appendix.

ness upon palpation of this region. But an elongated mass was felt here. Blood count: 6700 leucocytes, 47 per cent polymorpho-

nuclear neutrophiles, 43 per cent lymphocytes, 6 monocytes and 4 eosinophiles.

*Operation:* the appendix was 15 cm. long and 3 cm. wide. The subserous vessels were hyperemic. The base of the appendix appeared to be invaginated into the cecum for a distance of 1 cm., so that it had to be dissected out of the intestinal wall by the knife. The amputated appendix appeared to be filled with a smooth substance of paste-like consistency. The different layers of the wall were easily discernible. The lumen of the appendix measured 2.5 cm. in diameter. After the appendix was opened by a longitudinal section, a mass was removed consisting of smaller and larger yellowish white, opalescent globules surrounded by a clear gelatinous material.

The *microscopical examination* showed a mucosa consisting of a single, straight layer of high columnar, mucus-producing cells. The lining was frequently defective. The cylindrical epithelium showed evidence of regressive changes at the periphery of the defects. The cells became gradually lower and smaller till they disappeared completely as a delicate, dark line. Glandular formations were only occasionally seen. The submucosa was fibrous in character and more or less densely infiltrated with eosinophilic cells, leucocytes and lymphocytes. In the cecal portion of the appendix areas of mucinous imbibition of the submucosa were encountered (Fig. 1). The epithelial lining covering these myxomatous zones consisted of narrow, dark-stained, indistinctly outlined cells. The muscularis was thickened and showed an eosinophilic and lymphocytic infiltration of moderate degree. The mucoid globules consisted of mucin and pseudomucin and were sometimes surrounded by a leuco-

cytic coat. In a section from near the cecal end a small papilloma was present. It showed a very vascular loose stroma with finger-like projections covered by a rather irregularly shaped, somewhat vesicular epithelium with round, hyperchromatic nuclei. The epithelium of the adjacent parts of the appendix was composed of similar cells (Figs. 2 and 3).

#### CONCLUSIONS

It is thought that the small papilloma was the cause of peristaltic contractions of the appendix resulting in its invagination into the cecum. The compression of the cecal os of the appendix thus produced is the cause of the retention. The continuation of peristaltic movements may have produced the globular arrangement of the mucus. Considering the rather atypical character of the epithelial lining of the papilloma, a rupture of the appendix might not have proved as harmless as generally observed.

I am indebted to Dr. P. Kreuscher for the history of the case.

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# ANATOMIC RESTITUTION OF A FRACTURED CLAVICLE<sup>1</sup>

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THE fractured clavicle as usually met in general practice causes no great concern to the surgeon. Any one of the

usual adhesive strapping had been applied immediately after the accident, but a protrusion due to the overriding outer fragment,



FIG. 1.



FIG. 2.

many accepted methods of partial immobilization offers the probability of an excellent functional result. However, the frequent residual swelling and decrease in the width of the shoulder, while unimportant to the steel worker, may be objectionable to the lady whose evening dress forms an essential part of her wardrobe. This report concerns such a case. At the suggestion of Dr. Armitage Whitman, in whose care the patient was placed, the following method of reduction was successfully applied. We believe it to be original and useful.

Mrs. E. G., aged twenty-nine, fell from her horse two and a half days before admission to the hospital, fracturing her clavicle at the juncture of the middle and outer thirds. The

and the coincident asymmetry of the shoulders caused considerable anxiety. She applied for further treatment to reduce the deformity.

Her past history and general physical examination are irrelevant. There was no pain, very little tenderness, and no circulatory or nerve disturbances. In short the case was that of a typical "broken collar bone."

A roentgenogram confirmed the diagnosis, and is herewith presented (Fig. 1). The left clavicle between the middle and outer thirds is fractured transversely; the outer fragment overrides about 2 inches.

The patient was taken to the operating room and placed upon a Hawley table. Her head and neck rested upon the shoulder piece; her waist and hips upon the main body piece. The shoulder piece was pulled out as far as possible, leaving the back of the patient exposed except for the narrow metal strip connecting the two parts. In this position the shoulders and back were free for manipulation. A double layer of felt  $2 \times 3 \times 4$  in. was placed between the scapulae, resting on the connecting strip. This served to elevate the interscapular region.

<sup>1</sup> From the First Orthopaedic Service, Dr. Royal Whitman, Hospital for the Ruptured and Crippled, New York City. Submitted for publication October 11, 1929.

The left arm was allowed to drop posteriorly and then brought to 100° abduction. This position was maintained by an assistant. It must be emphasized that the posterior drop of the arm and shoulder was entirely gravitational. The opposite shoulder, unrestrained, serve as a balance.

In this position it was apparent to the operators that the protrusion over the site of fracture had disappeared. Sheet wadding was wrapped about the left arm and shoulder, and around the trunk from the axilla to the iliac crests. Over this a plaster-of-Paris spica was applied. The head piece was pulled cephalad, thereby removing the connecting rod from the spica, and the patient was placed on a stretcher. Shortly afterward the plaster was trimmed, exposing the clavicular area, and a portion was removed over the anterior surface of the forearm and antecubital space. This permitted motion at the elbow, and the patient could use her left hand in eating, card-playing, etc. (Fig. 2).

After forty-eight hours the patient was permitted to sit up in a chair, and even to walk. A second roentgenogram taken a few hours after reduction shows complete restitution of the fragments to their normal positions (Fig. 3).

Thirteen days later the spica was removed. The symmetry of the shoulder was perfect.

A slight swelling over the site of fracture, while palpable, was barely visible. The patient was then given a supporting sling, mainly

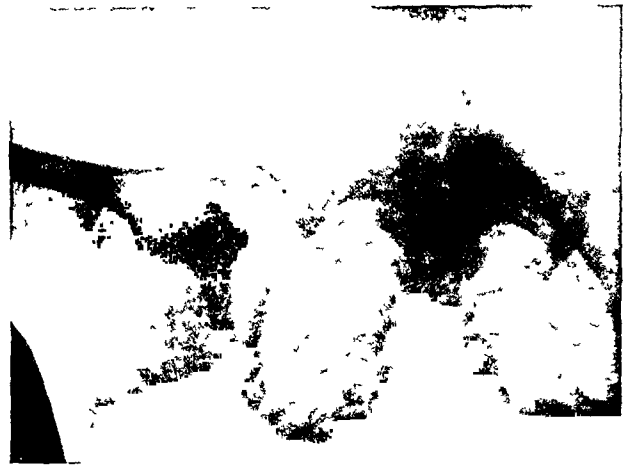


FIG. 3.

as a reminder to care for the shoulder during an impending long train voyage.

This method of reduction is one to be used in those cases of fractured clavicle in which anatomic restitution is necessary to prevent deformity. True, it appears cumbersome, but ten to fifteen days so spent may save many moments of embarrassment later.



## TWO INTERESTING HAND CASES\*

LEO MAYER, M.D.

NEW YORK

**M**Y purpose in the case reports is to illustrate methods of conserving tendon function and to show the technic of tendon transplantation which is applicable to this type of injury.

**CASE I.** A young boy cut his hand on a milk bottle a year ago. As is well known, milk bottle injuries are invariably infected; I have never heard of any that did not become infected. The physician who saw him did not try to attach the tendon at the time of the accident; he put in a drain and let the wound granulate, and at the end of three weeks referred the boy to me. The wound was well

healed. Cutting down on the tendon, I found the flexor profundus and flexor sublimis of the third finger had been cut through, leaving a space of about 2 in. between the two ends. Traction on the proximal stumps did not appreciably lessen the gap.

In a case of this kind, the simplest and most effective procedure is to sacrifice the sublimis and concentrate on the profundus. The operation is done by splicing a graft taken from the sublimis tendon between the stumps of the profundus tendon. The operation takes about forty minutes.

The postoperative care of these cases is

\* Read before the Section of Orthopedic Surgery, N. Y. Academy of Medicine, January 18, 1929.



tedious. Three or four months are required before proper function is restored.

The action of the transplanted tendon in this case is not 100 per cent perfect. I have not succeeded in getting perfect results; there is always a little slack in the tendon that I have not as yet been able to correct. This boy uses his fingers together very well, but on trying to use the third finger alone he cannot get it quite to the palm. The operation requires a rather fussy technic; we must operate quickly, for we cannot leave the Esmarch bandage on more than an hour.

The next case is an altogether different type:

CASE II. The patient scraped his hand on a nail, and developed a small infected spot on the dorsum of the hand. The infection looked very mild and I opened the abscess under novocaine. Some hours later the patient telephoned and reported that he was suffering severe pain, and on seeing him I found the wound surrounded by a black area about the size of a silver dollar. It made me suspect anthrax, and I rushed him to Dr. Stetten, who also suspected anthrax. I made a broad excision of the blackened tissues and packed the wound with hexylresorcinol. Despite the excision, his temperature rose to 102°F. the wound edges sloughed, and the infection continued to spread. A few days later I attempted a second excision and found that the infection had involved the entire dorsum of the hand; the skin was eaten away, the fascia was gone, etc., and the infection had extended up about two-thirds the distance to the elbow. The cultures

showed no anthrax bacillus only staphylococcus, with nothing peculiar about it except that it grew in anaerobic as well as in aerobic cultures.

At that time the patient was seen by Dr. Stetten and Dr. Herold Neuhoof.

I was very much disturbed, for the patient was a well-known violinist, and I thought he would never play the violin again. Dr. Neuhoof thought it looked like an anaerobic infection and advised the use of hydrogen peroxide. I got an arm bath and filled it with warm peroxide, and immersed the arm in it. In an hour the condition was slightly improved; in three hours the wound looked definitely better, and it was evident that the infection had been checked. Within two days, the wound looked normal, and in a week's time the entire hand was covered with healthy granulations.

Then came the question of how to cover that huge granulation area. Of course, it is necessary when dealing with skin over a superficial joint to use either a Wolff graft or a pedunculated graft. I removed a flap from the abdominal wall 11 in. long by 4½ in. wide. The graft healed very nicely. The patient has complete control of his fingers and is able to play the violin as well as ever.

The graft seems smaller than at the time of the original implantation; the cosmetic effect is not entirely satisfactory, owing to the thickness of the graft, but I hope to be able to improve that later. The most interesting point, however, is that we were able to save the function of the tendons. Another interesting thing is the ingrowth of the nerve fibers from the upper part growing downward, so that the patient has sensation over one-fourth of the graft.



# MESOTHELIAL TYPE OF MALIGNANT HYPERNEPHROMA

## WITHIN A SOLITARY CYST OF THE KIDNEY\*

J. SYDNEY RITTER, M.D.

NEW YORK

MRS. M. T., aged thirty-seven years, married, was referred to me on July 6, 1927 by Dr. L. A. Shifrin. At this time the patient complained of a palpable mass filling the right side of the abdomen together with severe, piercing pain in this region which radiated dorsally.

The family and past histories were irrelevant.

The present illness dated back to March 1927, on which date the patient had a similar attack of pain and fullness which lasted a few hours.

On her first examination the physician made the diagnosis of a possible ovarian cyst; however, when examined by a gynecologist a week later a definite denial of an ovarian cyst or any tumor was made. She had had three other attacks following this one with similar experiences and not until the patient came under the care of Dr. Shifrin was renal disease suspected. He suggested a complete urological examination. From the history of the case we made a tentative diagnosis of intermittent hydronephrosis, the causative factor not being determined, but advised hospitalization for study.

July 6, 1927, she was admitted to the New York Post-Graduate Hospital, at which time the complete examination was made:

*Physical Examination:* Fairly well-nourished adult, female, weighed about 128 lb., in good general physical condition. Heart and lungs were normal. Abdominal palpation revealed a firm, tender, palpable mass in the upper right quadrant which extended down into the pelvis on the right side.

By vaginal examination this mass was found not to be attached to the uterus, as shown in Figure 1.

*Cystoscopic Examination:* A No. 24 McCarthy cystourethroscope was introduced. The bladder was found to be trabaculated. The vesical sphincter was normally located and normal in appearance.

Indigo carmine injected intravenously appeared on the left side in three minutes with good concentration in five; from the right side the dye appeared in eight minutes, with a 3 plus concentration in eleven.

Ureteral catheters were passed to both renal pelves without difficulty. Urine obtained from both sides was clear and negative but for a faint trace of albumin.

A pyelogram was then made on the right side, using 15 c.c. of a 12.5 per cent solution of sodium iodide. The patient complained of some pain in the region of right kidney. An x-ray exposure was made. The catheter was withdrawn and the ureter distended with sodium iodide and another exposure was made. Several x-rays were taken prior to the pyelogram.

*X-ray Report* (Fig. 2): July 6, 1927. Examination of the genitourinary tract shows the left kidney to be of comparatively normal shape, size, position and illumination; the lower pole was opposite the upper border of the third lumbar vertebra.

Examination of the right kidney after the injection of the contrast substance showed the kidney much enlarged. The enlargement was mostly towards the lower part. The lower pole was below the iliac crest. The kidney pelvis appeared to be normal. The calyces were somewhat irregular (Fig. 2). Diagnosis: solitary cyst or tumor of kidney.

*Operation.* On August 12, 1927 this patient was operated on. Through a right hockey stick incision the kidney was exposed; the upper pole was easily delivered, due to the fact that the entire kidney was rotated and pulled down out of its former location. From about the middle of the convex surface a distinct cyst-like tumor was found to be firmly incorporated with the kidney and extending well down into the pelvis. Due to some adhesions between the cyst wall and the peritoneum it was necessary to open into the peritoneum to determine the extent of the mass and the possibilities of its attachment to any intra-abdominal organ. I was particularly anxious as to its being in any way associated with the ovary and as to its relationship to the ascending colon.

With one hand in the abdomen I was able to free the peritoneum from the tumor; however this was not accomplished until I had separated the growth from the kidney. On

\* Read before the Section of Genito-Urinary Surgery, N. Y. Academy of Medicine, Dec. 18, 1929

cutting the tumor I noted a large clot of old coagulated blood together with many papillomatous masses lining the cavity.

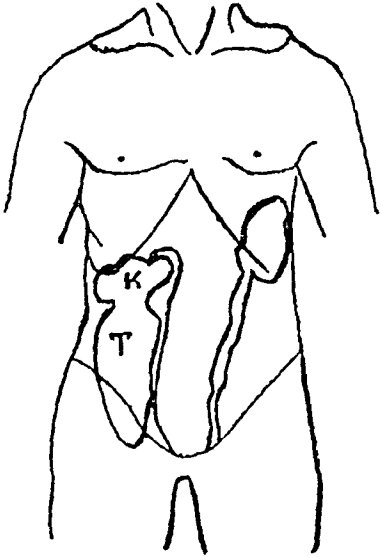


FIG. 1.

Due to the fact that some of the tumor was attached to the kidney a nephrectomy was done. On the operating table a diagnosis of cyst-adenoma simulating that of the ovary was made. The wound was closed in the usual



FIG. 2.

manner and patient returned to bed in good condition.

*Pathological Report* (Fig. 3): One specimen is a small kidney measuring  $95 \times 43$  mm. It has been removed with a small portion of ureter. At the convexity there is an excavation, ellipsoid in shape, which occupies a length of 55 mm. and a width of 33 mm. This excavation is more or less smooth walled, with a small amount of kidney tissue projecting in an irregu-

lar fashion. At one edge there is a small papillary projecting tumor nodule which apparently has been torn off from a larger cystic tumor

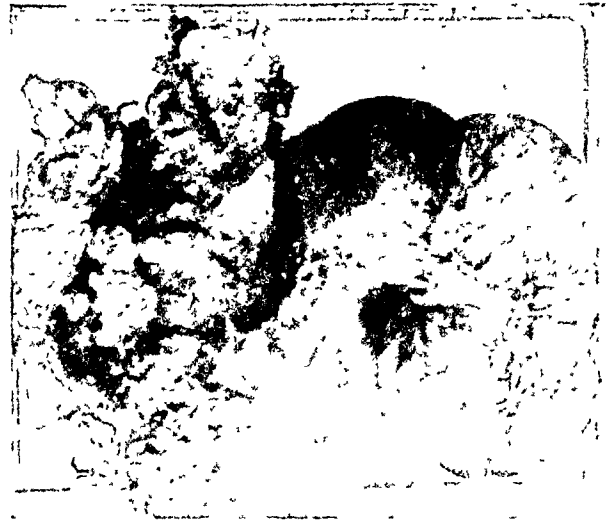


FIG. 3.

node. This small nodule measures  $15 \times 15 \times 14$  mm. It appears to be in connection with a tumor invading the kidney cortex proper which reaches a diameter of 14 mm. This invasive portion of the tumor can be seen to bulge out on the surface of the kidney opposite the nodu-



FIG. 4.

lar tumor in an irregular fashion for a distance of 19 mm. It is hemorrhagically discolored. The remainder of the kidney substance is negative. The cortical and medullary markings are well preserved. The pelvis and mucosa of the calyces is pale.

The second specimen is apparently a portion of a cyst wall which has been torn in several places. In its interior there are numerous larger papillary projecting nodules and several areas of dark brown, partly hemorrhagic clotted blood. This portion of the tumor, which apparently was in connection with the tumor on the kidney, measures  $135 \times 55 \times 23$  mm. The tumor nodules on the interior of the membrane are very firm.

*Microscopic Examination* (Fig. 4): The papillary material and most of the wall of the cyst are composed of irregularly interlacing bundles of rather large acidophile spindle-shaped cells with irregularly oval vesicular nuclei, only moderately rich in chromatin and usually showing a nucleolus. These cells are frequently fragmented and are more compact and better preserved immediately around the blood vessels. Striations cannot be found in them and they appear not to be muscle cells. Van Gieson stain reveals no collagenous fibrils between them. In general the granular character of their cytoplasm indicates the presence of lipoid, as the yellow color in the gross specimen would also suggest. In some portions there are large globules of fat in the substance; mitotic figures are not recognized.

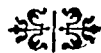
This is an unusual tumor. It is undoubtedly malignant and local recurrence with eventual extension is to be expected. It would appear to have developed from a remnant of displaced adrenal medulla beneath the renal capsule.

*Diagnosis:* Mesothelial type of malignant hypernephroma.

*Follow-up Report:* The further progress of this patient after being discharged from the hospital: She reported to the Memorial Hospital where she has been under the care of Dr. A. L. Dean, Jr., and a personal communication which I received this year is as follows: "I saw your patient, Mrs. M. T., on September 13, 1929. At that time she was enjoying perfect health and a physical examination revealed no sign of disease."

This case appears worthy of report due to the fact that in renal surgery, particularly where a diagnosis of cyst of the kidney has been correctly made, it is not sufficient to merely enucleate the cyst, but before leaving the kidney in situ it is advisable that the cyst be opened and examined for possible neoplastic growth.

It is of interest to attempt to explain the appearance and disappearance of this tumor mass. In the x-ray examination there was no communication between the cyst and the renal pelvis. We cannot therefor consider this to be a case of intermittent hydronephrosis but must accept the interpretation of the appearance and disappearance of the tumor mass as being due to intermittent hemorrhage together with reabsorption of the blood clot.



## TORSION OF THE TESTICLE\*

CLARENCE B. WHITTEMORE, M.D., F.A.C.S., AND LEONARD ZWEIBEL, M.D.

JOHNSON CITY, N. Y.

THERE are only 137 cases of torsion of the testicle reported in the literature, and it is therefore relatively rare. It is probably more frequent than is generally supposed, owing to the fact that the torsion may be only partial and that it may subside spontaneously with or without infection and under expectant treatment. The torsion consists of the rotation upon its longitudinal axis, causing thereby a sharp twist in the spermatic

cord which may consist of one-half to four turns in either direction. The blood supply is interfered with, hemorrhagic infarct of the testis follows and the gland either goes on to suppuration, or more frequently to atrophy. It is very likely that many of these testes undergo atrophy without being diagnosed.

The etiology is obscure and has not been definitely determined. It is believed to be due to some congenital malformation

\* Read before Endicott-Johnson Medical Society December 4, 1929 at Johnson City.

affecting the anchorage of testis and epididymis to its tunical bed, which gives the testis greater mobility than is normal. The undescended testicle is apparently peculiarly subject to torsion. It generally occurs through being induced by muscular effort, particularly of a sudden, severe sort, although it has been reported as having occurred during sleep in several cases. Torsion may occur at any age, but is chiefly seen between the ages of thirteen and twenty-one years of age.

The most frequent torsion is the intra-vaginal type, where an abnormally long mesorchium exists. Others are extra-vaginal, in which the entire testicular mass, including testicle, epididymis and tunica, rotates within the scrotal wall so that the cord is twisted in its extra-vaginal position.

The pathology is commonly agreed upon. The skin and subcutaneous tissues are thickened and edematous. The tunica is infiltrated and contains a thick, almost black, fluid. Usually there is a general thrombosis below the twist which, as previously mentioned, may vary from one-half turn to four turns, and the testicle may undergo hemorrhagic infarction with commonly resulting gangrene, or interlobular hemorrhage or atrophy, which is most common. If infection supervenes from the blood stream, the infarct suppurates and discharges to the outside. If there is simple necrosis with no infection, the exudate is eventually resorbed, the necrotic tissue replaced by scar and complete fibrous atrophy finally results.

The symptomatology is not pathognomonic, although very suggestive. The onset is sudden with severe pain in the testicle and there may be nausea, vomiting and even mild shock, perhaps due to vagus nerve fibers. The temperature may reach 100°F. or higher. Swelling is noticed on the affected side, in either the scrotum or inguinal canal, with redness and edema of the skin which may go on even to an extreme degree. The testicle usually is not palpable in the scrotum due to the

degree of swelling and fluid. Both local and general symptoms are exaggerated when the testicle is in the inguinal canal, and may very closely resemble in symptomatology a strangulated hernia.

**CASE REPORT:** Infant boy, white, 8 months old, admitted October 8, 1929 to the Charles S. Wilson Memorial Hospital, Johnson City, N. Y. The child had been crying continually since the previous day, as if in pain. Had vomited on the previous day, as well as on the day of admission. Temperature on admission was 100°F. The patient had a fairly severe cough on admission. The mother noticed a swelling in the right inguinal canal since Oct. 7, 1929.

The child was a normal delivery and was normal physically but for umbilical hernia, first noticed at two weeks of age. Had been breast and bottle fed. Family history showed two children in family had whooping cough.

On physical examination, the child did not appear acutely ill, but had convulsive coughing spasms. Pupils reacted equally to light and accommodation. Nose and ears were negative. Tonsils and pharynx were markedly inflamed. Neck was negative. Heart and lungs were negative. Abdomen showed small umbilical hernia and mass in right inguinal canal size of a large walnut over region of external abdominal ring with long axis parallel to Poupart's ligament. The skin over the mass was tense, firm and red. The mass was tender and immobile, apparently adherent to the superficial and deep tissues. The testicles were not palpable in the scrotum. The left testicle was palpable, not enlarged, in the left inguinal canal.

The child had been sent to the hospital with the diagnosis of strangulated hernia.

On admission to hospital, Oct. 8, 1929, after above physical examination, diagnosis was made of: (1) traumatic oedematous undescended testicle on right, (2) upper respiratory infection.

The operation in right inguinal canal demonstrated a tense tunica vaginalis with much thick, dark fluid. There was torsion of the testicle which was gangrenous and appeared with the epididymis like one large undifferentiated hemorrhagic clot. There was marked gangrene and thrombosis extending up the spermatic cord to the external abdominal ring. The right testicle and cord were

removed and herniotomy repair performed (Bassini).

All symptoms but the cough disappeared after operation. The cough disappeared at the end of the third week.

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## UNUSUAL FOREIGN BODY IN THE CHEEK

RICHARD JOSEPH WHITE, M.D.

FORT WORTH, TEXAS

THE shell of a .22 cartridge in a masseter muscle is, I think, a really unique condition. An eleven-year-old boy was brought to the hospital with a story that three weeks previous in a small town one hundred miles away he had been playing with an old type of single shot breech loading .22 rifle which "broke" in the middle. This was designed for a .22 short cartridge. The boy got hold of some .22 long ammunition and when the cartridge failed to go in completely he held up the open barrel and tried to push it in with a pocket knife. It went off and the bullet lodged in the gun barrel. The shell was thrown back and entered the left cheek a half inch behind the angle of the mouth. Nothing was done for three weeks and most of the swelling had subsided when he was taken to a hospital and an incision was made inside the mouth in an attempt to locate and extract the foreign body.

This failed and I first saw him two days later with a very extensive cellulitis of his left

face and some trismus. He was sent home. Mouth irrigations and cold applications were ordered and an analgesic given. He got worse and two days later was admitted to the hospital where the same regime was continued. The second night after admission an abscess burst inside his mouth and the edema and temperature rapidly subsided. An x-ray now showed the shell of a .22 long cartridge slightly behind and above the left lower unerupted last molar. Under general anesthesia an external incision was made in the direction of the facial nerve fibers and the parotid duct. The foreign body could not be felt. Confident that it must be near, an incision was made in the masseter muscle and a large cystic space filled with sanguinopurulent material was opened. The shell lay in this. It was extracted and the cavity packed to control hemorrhage. The wound was closed with a gauze wick emerging through the skin. At first there was a noticeable muscle weakness about the angle of the mouth, but this has practically disappeared.



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## EDITORIALS

### POST-GRADUATE EDUCATION

IT is that of a layman, purely, my interest in post-graduate medicine.

An informed layman, perhaps, since as Commissioner of Public Welfare in the largest American city for eleven years, and as Controller of the same city for four years, I have been brought into close contact with hospitals, private and public, and with the physicians employed in and attending them. But my point of view is that of a layman primarily, of the fellow who is to be treated and not the fellow who is to treat such ailments as may afflict my body and bones. I want to be sure that my doctor knows his business, that he is to treat me, when I suffer from some of the ills that afflict mankind, as a sufferer whose pains are to be mitigated, who health is to be restored and not as a specimen from

which he may learn something about pathology. In other words I want the doctor to know his job before he starts to work on it. Now, after a long and ripe experience, I want to join in a program that would give physicians the opportunity of obtaining such experience and knowledge.

It is quite natural, I suppose, that a young licentiate in medicine should desire to capitalize his knowledge as soon as possible. He has spent his years at preparatory schools and his college of medicine. He has heard his professors, attended his clinics, read his books. He has passed all his exams. He has his certificate as a doctor of medicine. He has the state license to practice. Let's go!

But every experienced physician knows

that as soon as one confronts life he finds conditions of which he never heard in his school, or which seem to him so entirely different in fact, from his academic conception of them that they call on him for original thought which should be guided by a profound and varied contact with facts. What chance has the young fellow who has his doctorial degree fresh in his consciousness and no post-graduate experience and who goes out to practice? He may go to the country where there are few hospitals, or none. He may have to learn at the cost of patients, something which he will regret deeply if he be the right kind of a man under the right kind of a doctor. He will learn, of course, but slowly. Medicine may in its rapid progress get entirely beyond him and he may become an old foggy, a frustrated man, and even descend to a form of quackery all the more offensive because he has the license of the state to practice and the knowledge that the earth will cover his mistakes.

When I was Controller, it was my business to look after the finances of the City's public hospitals, and then I found that experience as internes in these hospitals and as staff attendants was desired by most young doctors. The most ambitious minds sought them from our own city and from the whole nation. I found that Bellevue was aiding the city medical schools. Later when I became Commissioner of Public Welfare, operating directly 15,000 beds of all kinds, this phase of city hospital work became to me more apparent and most important. In view of the problems of post-graduate needs in medicine which constant contact with the members of the Committee on Public Health Relations of the New York Academy of Medicine, eminent local doctors and the leaders of the American Medical Association, the American College of Surgeons and the American Hospital Association, impressed on my mind, I felt that a vast amount of medical material in many of the great institutions of the city was going to waste, and that this waste

was at the expense of the patient. From this, I became convinced that hospitals connected with medical education gave the sick the best attention. I tried to meet this. I started post-graduate lectures and clinics in the great Kings' County group in Brooklyn, and in the Metropolitan Hospital cooperated with Flower College in a rather complete course, which the College considers to be most successful. I did my best to start them in every one of our hospitals. I tried to get a vast pathological laboratory constructed at Kings' County Hospital and a liaison established between that group and the Long Island College Hospital Medical School, but—well, there are politics in medicine as well as outside, and my efforts were nullified by unfortunate circumstances. However, my interest in post-graduate medical work is still keen and I do hope that the time will come when all the great city hospitals, public and private, will aid in making the young graduate in medicine a better man for his job of aiding suffering humanity.

I want to be of service, not alone in extending greater facilities for post-graduate work in the City of New York, but in other great medical centers of our country. There are many liberal and broad-minded men and women in rural or semi-rural communities who could not do a better turn for their neighbors and themselves, than by financing the post-graduate education of doctors that are treating and attending them. I have talked with many of the most able and conscientious of the hundreds of internes seeking to learn the reason of their aversion of residing in well-paying rural or even fairly large towns. The answer of almost all was that this would bury them and that they could not keep in touch with their profession. For the benefit of the health and lives of our people, I hope that the AMERICAN JOURNAL OF SURGERY can start and carry through a discussion, out of which we can get together and form a plan that will bring the doctor from even the outpost of civili-



zation, in touch with the latest progress in medicine and surgery.

BIRD S. COLER.

Former Commissioner Public Welfare,  
City of New York.

[This communication] is worthy of unu-

sual consideration, as it gives a lay viewpoint of an important phase of Medical Education by a man who is recognized as an expert on such matters, because of his long experience as the governing head of The City Hospitals of greater New York. ED.]



## GONORRHEA: A CRITIQUE\*

DURING the last few years I have written and talked so much about the laboratory and clinical phases of gonorrhea that I have not the courage to bore you further with them. For this reason, and the fact that of late my mind has been turned more constantly in that direction, I have chosen to discuss the broader aspects of the matter, the relation of the disease to mankind at large and the profession of medicine in particular; to sketch conditions frankly as I think they are and to try to point out some things that must be done if the present unattractive picture is to be changed for the better. If, at times, the criticisms seem destructive I am going to ask you to bear with me for there is no wish to be offensive or unkind. At times the frankness may seem harsh but time does not permit of dressing each thought in honeyed words to soften the blow, even were it in my power to do so. The plain, blunt statement of a fact usually is more arresting and there is no subject in all of medicine in which plain talking is more needed.

That you may immediately sense the importance of the disease I shall briefly outline a few estimates of its prevalence. This would seem unnecessary to such an audience but I doubt if any of us fully realize what the disease is doing. You may question the accuracy of the figures given and they will not suffer greatly if you cut them in half.

It is estimated that from 60 to 90 per

cent of all males in large cities have gonorrhea at some time during their lives; that 20 per cent of all married men contract the disease at some time during their married lives and of these 45 per cent infect their wives; that from 40 to 60 per cent of all operations on the uterus and its adnexa are thus occasioned; that gonorrhea accounts for at least 5 per cent of all blindness. Added to this is a sum total of human misery that is staggering and, last, but perhaps not least, is an economic loss that runs into millions of dollars.

If these estimates do not strike you let me quote a few figures given in Dr. Haven Emerson's report after an exhaustive health survey of my own city, a city that I think you will agree with me is as clean as any city in the country having more than half a million people. Dr. Emerson estimated that we develop more than 159,000 new cases of gonorrhea and syphilis annually and that the incidence of gonorrhea is at least five times as great as that of syphilis. Let me go further with his figures, and remember that these figures are not idle guesses but represent months of the most careful investigation of the question from almost every angle at cost of many thousands of dollars.

He found that 45,800 of these cases are treated by recognized medical agencies and at least 114,000 have no trained medical supervision whatever. It is further brought out that 33.3 per cent of our druggists admit that they treat these

\* Read before the New York Academy of Medicine, Section of Genito-Urinary Surgery, October 16, 1929.

diseases, though it is directly against the law of the commonwealth, 23.2 per cent of them refuse to commit themselves on the subject and 43.5 per cent say they send such patients to physicians or clinics. It was not possible to learn or to estimate how many were treated by quacks and charlatans. When the inquiry as to what they would do if they had a venereal disease was made of 100 individuals chosen at random in pool rooms, barber shops and other public places, a rather surprising state of affairs was shown to exist. Forty-two per cent said they would consult a druggist, 24 per cent a physician, 16 per cent a clinic, 4 per cent would use a home remedy and 14 per cent did not know what they would do.

Surely, as guardians of the public health, we have much food for thought in these figures. We cannot appease self-conceit by calling them merely local and an expression of what you are facetiously pleased to call Philadelphia somnolence. Similar conditions are being demonstrated in each of our large cities and certainly the reporting of 159,000 cases of the venereal diseases each year, in a city of 2,000,000 inhabitants, would seem to brand us as rather wide awake. No one has ever thought that the medical profession of my city is asleep, as the record throughout the years has shown it to be rather an alert body.

Let us make no mistake about it. The above conditions are national and they cry so loudly for correction that it behooves us to give them the most serious consideration. Obviously something is radically wrong when so large a proportion of that great group of diseased individuals does not even choose to consult us. The business man would call it wretched salesmanship but the fact is, insofar as gonorrhea is concerned, and most of these cases are gonorrhea, we have not even tried to sell anything. In this regard we have drifted so long that I fear the fault has become public property and in the eyes of the social-minded our profession is definitely

on the defensive. This we perhaps would do well to admit. Faults are rarely corrected until they are admitted.

Insofar as we are concerned, wherein lies the fault? Unquestionably our greatest fault in regards to gonorrhea has been a most unfortunate lack of medical interest in it and its victims. We have been so busy thinking of more attractive things that we have allowed this one to drift along bearing the heavy mosses of other years. One might appropriately borrow a term from the sociologists and call our present position one of the "Costs of Progress," for every human gain is made at some cost.

Twenty years ago we knew almost as much about gonorrhea as we do today and very few doctors thought it beneath their dignity to treat it. Some even specialized in it and called themselves genito-urinary specialists. Then some grew rather proud for such a name and the designation urologist was adopted. This was perhaps in the line of progress; but, as it grew in dignity, it grew to mean bigger and bigger things and, though it still embraced the smaller things, it gave them scant attention. There was formed a national association of urologists and about fifteen years ago this body took great pride in the fact that it put across an annual program without any papers upon the so-called venereal diseases. One cannot severely criticize this, however, for the papers on venereal diseases were of a type, as a rule, that should not have been presented before such a body.

Much of our urological progress has been due to the stimulus to scientific work given by the American Urological Association and today American urology commands the respect of the world. The lure of surgical urology, however, has relegated gonorrhea to a place of obscurity and many urologists have grown so proud that they hesitate to admit that they treat such a lowly disease; in fact, some even deny it. Surely we have progressed at a terrible human cost.

Gonorrhea either belongs to the realm of Urology or it does not. We all feel that it does and perhaps it would have fared better if our National Association had exhibited more tolerance and encouraged thought upon the subject by patiently listening to a few papers on it each year. Certainly nothing that afflicts the human race is too lowly for the physician to consider, and if we find ourselves growing too proud over our remarkable progress we can find ample reason for humility in the contemplation of that vast horde of afflicted that do not even "choose to run" in our direction but prefer the druggist and the charlatan.

Turning, then, to a consideration of things as they are, we find ourselves faced by a number of perplexing conditions that are by no means easy to surmount. We find an awakening interest upon the part of our profession on the one hand and a public that is in no sense social disease-minded on the other, all influenced by a public press giving columns to love and its roses and not daring to mention the name gonorrhea, its greatest thorn. We find genitourinary dispensaries in most of our hospitals occupying quarters that no one else wants; woefully inadequate for the numbers of patients visiting them; lacking in any possibility for privacy; so poorly manned as to compel herd treatment for the most individualistic of all diseases and totally out of sympathy with the governing boards of the hospitals, not because they dislike the staff but because they loathe the diseases treated by them.

Scientifically we are faced with an even more unfortunate state of affairs and, if we are to be honest in our analysis of what we know or do not know, we are forced to make some painful admissions. Let us make the great one first. We know little more about the disease and its treatment than we did twenty years ago and much of what we think we know will not bear too close a scrutiny. In fact there is a crying need for an entire restudy

of the disease to the end that we may discard the huge mass of misinformation that has accumulated about it. Much of what passes for science in this regard is not even good pseudo-science; often it is ridiculously erroneous. We could abandon with profit much of what we think we know about the gonococcus, for an enormous amount of it is simply not true. Our knowledge of the microscopic pathology of the disease has had little if anything added to it in thirty years. What we style "knowledge" of the immunologic aspects is a mass of contradictions. We have little knowledge of the true curative processes except that patients do get well; but we do not know how or why. When we view the clinical side of the question we encounter a maze of confusion with little uniformity of opinion or belief. And, when at least we turn our thoughts toward cure, we find ourselves in a veritable ocean of dreams. It looks as if we have neither rudder nor compass to our ship, and though we may know where port is, we often choose weird and windswept courses to reach it.

It is a great misfortune that a disease that afflicts such a large proportion of the human race should exhibit, perhaps, the most delicate immunity-balance of all diseases, for it is this feature of it that gives us our crowning perplexity. So adversely influenced is the disease by seemingly innocent things that we have always been hampered by its clinical vagaries in our efforts to evaluate properly our plans of treatment. It is only when the personal conduct of the patient is above reproach that one may differentiate surely between patient-faults and treatment-faults. Occurring as it does most commonly in those years of life when desires are strong and inhibitions halting, it is natural that it should have seemed so impossible of classification, with variations as numerous as the cases. And because of these things we have almost an endless number of plans of treatment and perhaps none of them has ever had what might be called a

scientific, well-controlled trial. Wherefore, there is urgent need for an entire restudy of these methods carried out upon patients where they are under constant observation and cared for by deeply interested physicians really familiar with the disease and the things that so quickly change the clinical picture. Lacking generally the facilities for hospitalization of gonorrheal cases, it would seem that the various branches of the governmental service, where large numbers of such patients can be readily restrained as to certain activities, might find a valuable work waiting at their doors.

So much for some of our perplexities. What are the modern trends of thought and action? One only has to question a few of that increasingly numerous group of social-minded individuals who spend their lives on the borderline between the doctor and the afflicted, to learn that they are keenly alive to the great need for action regarding the prevention and better treatment of the so-called "social diseases." Governmental agencies and social agencies within the last few years have been awakened as never before (except, perhaps, during the World War), are treading upon our heels and, unless we respond, we shall be pushed aside by the great demand for action.

We dread big business in medicine and, in this regard, we offer a golden opportunity for its entrance. Unless we as a body give the matter earnest attention we shall have duplicated in every large community just what has taken place in our second largest city. There has been built up in it an enormous institution doing, in its own way, and in competition with our profession, a thing we have failed so completely to do. And, though we may call its methods unethical and doubt the wisdom of some of the things it does, the fact remains that it is in its way filling a public need that we have allowed to arise. If it were not filling such a need it could not have the sponsors that it has.

They are too wise in the way of business to sponsor a needless thing.

It is becoming increasingly simple to interest individuals of great wealth in this phase of medicine and I am given to understand that even now one of the great "foundations" has given a kindly ear to the question. An institution in a neighboring city has been given a large fund and I am told that the venereal problem had much to do with it. I am further informed that your own city has been surveyed with this thought in mind and that the only reason why you have not an enormous institution for the treatment of these diseases, working in financial competition with you, is that you have a peculiar state law that curtails its publicity efforts. If this is true, it might be well for a committee chosen from your numbers to watch that law until such time as you so change present conditions as to make such a step on the part of big business unprofitable. Unquestionably this is the "handwriting on the wall" and, if we would save the situation we must put away petty feelings and work in harmony, for, if these things happen in one field of medicine, none will be immune against them.

If, on the other hand, an abounding humanitarianism makes us feel that as an individual, the physician has served his purpose and that the human race will be far better off when most of us seek other fields and the rest of us become cogs in some great medical institution which sells our services to whoever comes to buy, we have only to sit and wait. Wealth has scant regard for what we call medical ethics and is not willing that it should stand between us and public service.

What shall we do about it all? Apparently we have lost or have never had the confidence of an enormous number among our population. The rather obvious reasons for some of this have been previously discussed. When a business finds itself in such a predicament it tries to improve its product and it goes after

customers, from both of which moves we might learn. Certainly we must improve our product and just as certainly some form of dignified, ethical and concerted effort should be carried out to make our communities venereal disease-minded, for, unless the public is aware of the great menace of these diseases, we can hope for little in the way of greatly reducing their prevalence. With countless numbers of infected individuals throughout the land being "treated" by the druggist and the quack without any medical supervision whatever; with a medical profession not altogether alert to the seriousness of the problem; with a knowledge of the disease that has not yet reached a stage wherein there is much uniformity of procedure, a knowledge often unfortunate in the survival of treatment plans that could only prolong the infection, unquestionably we have much ground to cover.

Let us discard that sense of pseudo-niceness that makes some of us too proud to admit that we treat such a disease. If we cannot arouse an interest in the disease and in its victims, sufficiently great to make us willing to carry out the required procedures, let us be honest and not treat it at all. It is too serious a disease for makeshifts in treatment.

By the nature of things most of the preventive work must of necessity fall upon our shoulders. It must rest on the proper care of the disease when present, the proper control of those afflicted and the proper instruction of those patients whom we think we have carried on to a cure. Without the cooperation of the diseased, our efforts at cure and prevention must come to naught, and without a kindly attitude toward them we cannot gain that cooperation.

We must strive to make a better type of treatment available to the poor under conditions of privacy more nearly approaching that afforded our office patients. To do this we must entirely revise the common dispensary methods. The usual genitourinary dispensary is a gloomy,

ill-fitted place having so few physicians in attendance that the order of the day must be the greatest good to the greatest number, with privacy and individual encouragement for none. Until we can correct these conditions universally we encourage commercial exploitation of the poor.

We must in our dispensaries, at least, cooperate with the established social service agencies, for, no matter how much we may question their former activities, the fact remains that today they are, by and large, a body of specially trained individuals and without their help a genitourinary dispensary can only haltingly fulfill its great purpose.

In bringing about a general change in dispensary methods we are sure to encounter some great difficulties. We must start by convincing the hospital governing boards that they are necessary. We must make the case so strong that funds will be forthcoming to effect the necessary changes in physical equipment or we must find the funds, a thing not so difficult today as it would have been a few years ago. The data obtained by the United States Public Health Service and the American Social Hygiene Association in their various surveys give a wealth of convincing argument.

As the quickest way to bring about such an improvement and perhaps in a measure force the hand of those hospitals unwilling to join the march of progress, the suggestion has been made and, if properly carried out, I see no great fault in it, that each large city have at least one independent, model clinic for the proper treatment of venereal diseases among the poor. Such institutions should be started by the physicians and not by the laity. There should be on the governing board physicians of the highest type who have nothing to gain financially by the association. There should be associated with them laymen of such outstanding position that they have nothing to gain beyond the mental satisfaction of things done in a

worthy cause. Such a clinic should be run in cooperation with the physicians and existing hospital dispensaries, and never in competition with them, and the medical members of such a board should at all times see that nothing of a harmful and unethical nature is allowed. These centrally located institutions should have every patient interviewed by a social service registrar and should refuse to treat any patient who is financially able to pay a physician's fee. It is only by so doing that they can obtain and hold a kindly place in the scheme of things. Such a clinic should in every way strive to serve as a model to the end that existing institutions will be glad to copy its methods and it should be willing to discontinue the treatment of patients just so soon as it can be shown that existing hospital dispensaries have reached a plane rendering the model dispensary no longer necessary. The governing board, however, should continue to function as an educational medium for the public, for unless a community can be made and kept venereal disease-minded, it will soon sink back into the position from which it was only temporarily raised.

If, as is possible, you disagree with the idea of a model central clinic not belonging to any hospital but to all, you must of necessity face the evils of present conditions insofar as the treatment of the poor is concerned. These evils are glaring ones and they will not find correction until we show a lively interest in them. As has been said, the usual genitourinary dispensary is a dreary place wherein large numbers of patients must be treated by none too interested physicians while, what seems to be the world, looks on. There is neither the thought nor the possibility of privacy. Because of the number of patients and the scarcity of men willing to treat them, oral medication, in which few, if any, seriously believe, is the most common treatment. If local treatments are the order of the day they usually must be carried out by the patient

himself and their train of disabling complications usually is just what should be expected. The proper treatment of these patients in large groups is tedious and tiresome and until we find a way to remunerate the men who do it, we shall hardly correct conditions. Regret it as we may, the age of long apprenticeships in medicine has passed and our younger men cannot financially afford to treat the same things month after month unless it in some way yields an economic return.

There are, of course, many other phases of this important subject that might be dwelt upon with both interest and profit. It, however, would be kinder not to try your patience by prolonging the discussion further. It has not been my desire to be offensively critical; I have only wished to make you see conditions as they have grown to be and I cherish the hope that I may have been able to stimulate an interest in you that will transcend any hesitancy you may have had regarding this social outcast, gonorrhea, to the end that you may individually and collectively give earnest attention to the treatment and prevention of what well might be called "The Fourth Great Plague."

P. S. PELOUZE, M.D.

## NOTICE

WHEN the Radiological Department was added to this Journal, it was assumed as a matter of course that the articles on radiology should be collected together under the general heading DEPARTMENT OF RADIOLOGY. However, on reflection it does not appear that there is any good reason why these articles should be so segregated. In many instances it is really difficult to decide whether a communication should be classed under the head of surgery or under radiology, although it contains radiological data and observations of great importance. Swick's paper on Intravenous Urography, published in the February number, is a radiological article of greatest impor-

tance, yet of greatest importance to surgeons; and it really deserved a more prominent place in that issue of the Journal.

So while the Radiological Department will be continued as before, beginning with this issue there will be no special heading, but the articles will be scattered through the Journal as all other articles are, there being no particular reason for having a special heading for these when there is none for other subjects.

## INTERNATIONAL SOCIETY OF ORTHOPAEDIC SURGERY

AT A meeting of the Executive Committee of the International Society of Orthopaedic Surgery, held in London, February 1st, the following members were present: Sir Robert Jones of Liverpool, President; Prof. V. Putti of Bologna, Second Vice President; Dr. J. Delchef of Brussels, General Secretary; Prof. M. Maffei of Brussels, Treasurer; and Mr. Fairbank of London. At the suggestion of the French and German committees it was decided to propose at the next general assembly an increase in the membership of the Society. The next Congress of the Society will be held in Paris, October 2-4, 1930.

As a part of the program there will be two symposia. The first will be on the

subject "Treatment of Congenital Dislocation of the Hip after the age of fifteen Years." Reporters will be chosen from the United States, Germany, Great Britain and Italy. The second symposium will be on "The Treatment of Wrist Injuries" and reporters will be selected from France, Holland and Sweden.

The American committee is composed of Fred H. Albee, Chairman, William S. Baer and Henry W. Meyerding.

## SAMUEL D. GROSS PRIZE

THE Samuel D. Gross Prize of the Philadelphia Academy of Surgery has been awarded by the Trustees to Dr. Emile Holman, Stanford University Hospital, San Francisco, for his Essay upon "Abnormal Arteriovenous Communications."

## CORRECTION

IN the article on "Radiological Demonstrations of Pleurisy in Children" by Dr. E. Gordon Stoloff in the March Journal, the caption under Figure 7 should have appeared under Figure 9, that under Figure 8 under Figure 7 and the caption under Figure 9 should have been under Figure 8.

In the April issue the cuts on pages 852 and 853 were interchanged. The legends are alike.



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JOHANN VON MIKULICZ-RADECKI

[1850-1905]

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BIOGRAPHICAL BREVITIES  
"Mikulicz's Drain"

*The American Journal of Surgery*  
N S Vol. viii, May, 1930



## "MIKULICZ'S DRAIN"

JUNE of this year commemorates the twenty-fifth anniversary of the death of Johann von Mikulicz-Radecki, one of the greatest of the Continental surgeons who entered the stage prior to the age of Listerism and who lived to see surgery safely launched in the 20th century. Truly, he was a surgical giant and much of his work endures, without change, till this day.

Mikulicz was born in 1850 at Cernowicz, then in Austria. He received a liberal and thorough education at Herrmannstadt, and in 1875 was awarded the degree of doctor of medicine at Wien.

Almost immediately after graduation he entered Billroth's clinic and for six years was his assistant. From his assistantship to Billroth he went to Krakaw, where he became director and professor of surgery at the University. He continued in this position until 1888 when he was called to Königsburg to become the Director of the Clinic and Professor of Surgery. In 1890 he became professor of surgery at Breslau, which position he held until he died.

Mikulicz was a real surgeon, viewed from every angle. He had a surgical background, was a skillful technician, was unexcelled in the arts of diagnosis. His mind was of the inventive type, and he devised many new operative procedures. He was a teacher who knew how to impart knowledge to others. He did much to improve antiseptic surgery. It was he who devised the present modes of exploring the esophagus and the stomach. He was the first to treat cancer of the esophagus by resection and plastic transplantation. He introduced lateral pharyngotomy in excising malignant tumors of the tonsillar region. He was the first to use non-specific protein injections

for septic conditions of the intra-abdominal and pelvic organs. He did not know the rationale of this treatment but he observed that sometimes the patients improved clinically. He described the symmetrical inflammation of the lacrimal and salivary glands, which disease bears his name. He opened up new fields in gastric and joint surgery and devised several new operations. The operation for malignancy of the colon is named after him, as is the drain still commonly used in conditions of the abdominal cavity. He was the first to give the law that in thyroidectomy some of the gland must be left. In 1892 he collaborated in an atlas and in 1898 on a treatise on diseases of the mouth. He was one of the first to wear gloves in operative work. However, the gloves were of cotton, Halstead in America was the first to employ gloves of rubber.

Mikulicz was an accomplished musician. He earned his way through the university by money received for playing an organ from 5 until 8 A.M. He continued his musical enthusiasm throughout his life. He was a great friend of Brahms.

He had eight children, four sons and four daughters. All of his sons died except Prof. Dr. Felix von Mikulicz-Radecki of the University Frauenklinik of Berlin, who visited this country this spring and gave the writer many of the facts given here.

It is a coincidence that, having done so much operative work for the relief or cure of intestinal cancer, he should contract a malignancy of the stomach and undergo an operation from which he died, leaving a name known to surgery in every civilized country of the world, when but fifty-five years of age.

T. S. W.



[From Fernellius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

## SURGICAL INSTRUMENTS OF THE ELLICE ISLANDS\*

DONALD GILBERT KENNEDY, F.R.G.S.

VAITUPU, ELLICE ISLANDS, SOUTH SEAS

THE implements of primitive peoples have a fascination for the investigator. Sometimes one finds a specimen a purpose probably similar to that for which the first ancestors of our own implements came into being. The lancets

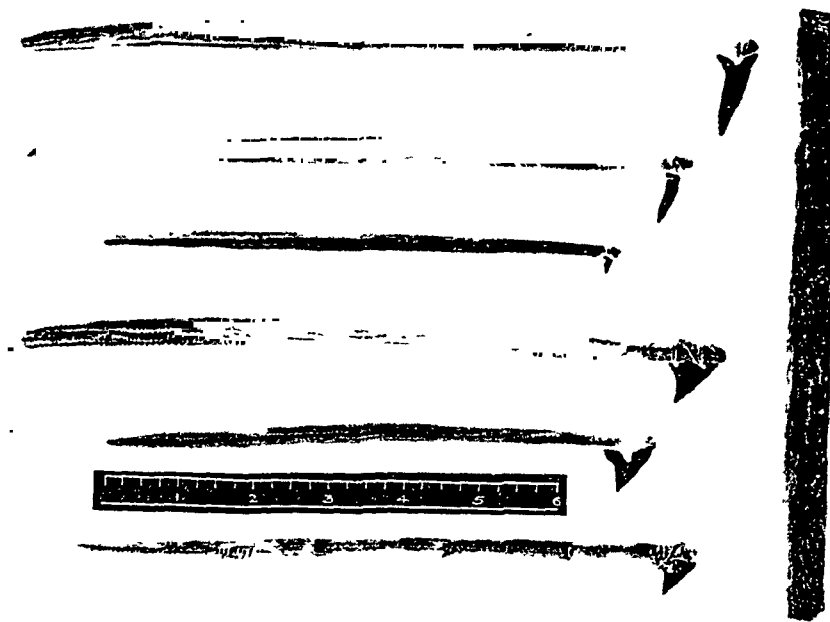


FIG. 1. Tapping mallet and six lancets collected by D. G. Kennedy from Vaitupu, Ellice Islands. These have been presented to Otago University Museum, Otago, N. Z.

men which is obviously the embryo from which has evolved one of our own highly specialized tools, but more often the examples are primitive collaterals developed from the material at hand to serve

herein illustrated are a good example of this type.

Throughout the islands of the Pacific the use of metals was unknown. Cutting edges were obtained from whatever ma-

\* Submitted for publication, January 8, 1930.

terial was available. In the high or volcanic islands, we find knives made from obsidian. Where bamboo was available its keen edge, when split and trimmed to the shape required, was found useful for cutting material softer than itself. Thus, in surgical operations, the lancet was frequently fashioned from bamboo.

In the low islands, however, the true coral atolls, such as those of the Gilbert and Ellice Groups, the bamboo does not grow and volcanic stones are absent. One might sift the soil from end to end of each one of the twenty-five atolls in these groups without finding a trace of obsidian, flint, basalt, or any pebble or grain of sand for that matter, which is not a fragment of sea shell, sea-borne pumice or coral.

Adzes were made from fragments of the shells of large bivalves while flimsy axes for hacking off green cocoanut leaves were fashioned from sections of turtle's carapace. The edges which could be given to these materials, however, while suitable, with frequent regrinding, for adzing and chopping, were quite useless for cutting knife-fashion.

The making of incisions in surgery therefore demanded a new material and this was found in the razor-edged teeth of certain species of sharks.

The method of fashioning these primitive lancets is shown sufficiently well in the accompanying illustrations of specimens which were collected by the writer on Vaitupu, one of the Ellice Islands. Those shown in Figure 1 have been presented by the writer to the Otago University Museum, Otago, New Zealand. In Figure 1 are shown a tapping mallet, three lancets made of short, wide, shark's teeth and three of long narrow ones. Their uses will now be described.

In order to make an incision, the wooden handle was held in the operator's left hand and the point of the tooth placed lightly on the region to be incised. A sharp blow was then delivered on the handle just behind the lashing threads with the wooden mallet held by the operator

in his right hand. The tooth was thus driven into the tissue making a clean and free incision.

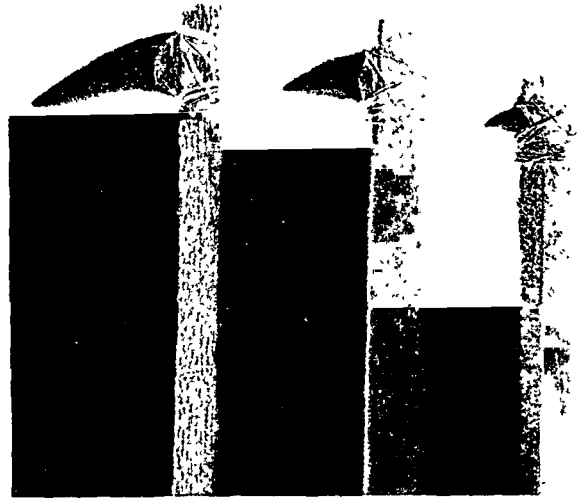


FIG. 2. Three lancets from Vaitupu, Ellice Islands, presented to Dr. E. W. Gudger, American Museum of Natural History.

When a long incision was required, a wide based tooth was selected (see Fig. 1, lower half). The handle was held at such an angle to the surface to be incised that when it was tapped with the mallet, only the front edge of the tooth (if that edge towards the handle is called "back") cut into the tissue. The instrument was moved forward along the line of incision being tapped with the mallet and leaving a clean cut in its wake.

Teeth of various shapes were used for different purposes and a *tufunga* (master) of this particular craft had always in his house at least one instrument of each variety. The particular purpose of the broad flat type has already been indicated.

The long type illustrated in Figure 1 was capable of making a deep narrow incision and was used for opening abscesses. The small variety shown in Figure 1, upper half, was used for blood-letting. Headache was often treated in this way, the skin being pricked at close intervals with the needle-like point tapped rapidly with the mallet as it was moved over the area of pain.

The instruments are rarely, if ever, used at the present day, the evidence of their

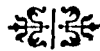
use, given above, being received at first hand from two old-time *tufunga*.

In reference to the making of long incisions mentioned above, in connection with the use of the broad flat tooth, it may be of interest to record an operation in which this was often required. This was the removal of a subcutaneous lipoma.

An incision was made over the tumour with the shark-tooth lancet. A fish hook was then inserted into the lipoma and the line to which this was attached was given a steady strain by an assistant while the surgeon cut away the connecting tissues

until the tumour was free. Blood was removed by another assistant who applied his mouth to the wound between strokes of the lancet.

Figure 2, a photograph of three lancets in natural size, shows in greater detail the teeth and their method of attachment (lashing) to the handle. These lancets and a tapping mallet were presented by the writer to Dr. E. W. Gudger of the American Museum of Natural History, New York City. The mallet and one lancet have been deposited in the ethnological collections of the Museum.



## BOOK REVIEWS

RADIUM IN GENERAL PRACTICE. By A. James Larkin, B.Sc., M.D., D.N.B., 28 illus., N. Y., Paul B. Hoeber, 1928.

In this age when many physicians have a more or less vague and disjointed conception of the indications for, and technic of the use of, radium, a book on the subject written so one need not be a super-physicist is more than welcome.

Dr. Larkin has written a book that every physician who meets with patients who may need radium applications to improve or cure their disease, or patients the physician decide to apply radium to, should carefully read.

After a preface the book is divided into five parts. Part I takes up General Considerations. Under this chapter heading the author considers the mechanics of radium, biologic reactions, methods of application in general, general technic, contraindications to radium treatment and dangers of radium application. This chapter alone is worth the cost of many works written casually on the subject.

Part II deals with General Diseases; Part III with Gynecological Diseases. Inasmuch as the modern gynecologist has occasion to employ radium in his work, cervical cancer being treated by many with radium and not by surgery, we urge the gynecologist to study this chapter; Part IV is devoted to Miscellaneous Tumors and Carcinomata; Part V, Miscellaneous and Skin Lesions, a chapter we recommend to every surgeon and dermatologist.

There is a complete Index. All in all it is an excellent, authoritative and timely book on a subject close to the majority of the doctors of medicine.

VARICOSE VEINS with Special Reference to the Injection Treatment. Ed. 2, rev. & enl. By H. O. McPheeters, M.D., F.A.C.S. 235 pp., illus. with half-tone and line engravings. Phila., F. A. Davis Co., 1930.

The first edition of this book was sold out in five months, an indication that it surely answers a definite need. The author has revised Chapter V on "The Trendelenburg Test" which, according to his Preface, was thought not to be detailed enough in the first edition. It is a well printed book that deserves the success it has achieved.

A TEXT-BOOK ON ORTHOPEDIC SURGERY. By Willis C. Campbell, M.D., F.A.C.S. 705 pp., 507 illus. Phila., Saunders, 1930.

Another textbook on orthopedic surgery, well written, well printed and well illustrated and covering the ground in fairly complete fashion in 705 pages. As the author admits in his Preface: "Our knowledge at the present time is far from complete, and as additional information is acquired our opinion on many subjects will probably be altered." "However," says he, "an attempt has been made to give a sufficiently comprehensive classification, especially of infections of joints, bones, and tumors, to afford a clearer exposition of the more complex subjects. . . No attempt has been made to describe all known methods of treatment, but only those which, in the judgment and experience of the author, are considered to be of practical value. The essentials of modern operative methods are defined, and in many instances the technic described for a better understanding of these principles."

In this attempt the author has been success-

ful. We look for improved and enlarged reprints for many years to come.

**PRACTICAL MASSAGE AND CORRECTIVE EXERCISES WITH APPLIED ANATOMY.** By Hartvig Nissen. Ed. 5, Revised and Enlarged by Harry Nissen. 271 pp., 72 illus. Phila., F. A. Davis, 1929.

This is the fifth edition of a work first published in 1889. It is, as its title indicates, strictly limited to practical massage, and it lives up to its title very well indeed. It is refreshing to see a work on any phase of physiotherapy that does not entail the expenditure of thousands of dollars for apparatus. In the opinion of the reviewer much of the good of modern physiotherapy can still be attained by the proper use of corrective exercises, and the indication for its proper uses are well stated in this little book.

**APPLIED PHYSIOLOGY.** By Samson Wright, M.D., M.R.C.P. With Introduction by Swale Vincent, M.D., LL.D., D.Sc., F.R.S. (Ed. & Canada). Ed. 3. 590 pp., 128 illus. Humphrey Milford, Oxford Univ. Press, 1929.

With the general recognition today that physiology is the foundation stone of modern medicine, there is definite need for a book of this kind. As Dr. Vincent points out in his Introduction: "The day has gone by when a practitioner, however, modest, can afford to declare that 'he has forgotten his physiology.'" This book on applied physiology is much better adapted to the needs of the physician in active practice who wishes to review his physiology, than is the average textbook. It might well be termed the "Practitioner's Physiology."

**GETTING WELL AND STAYING WELL.** A Book for Tuberculous Patients, Public Health Nurses, and Doctors. By John Potts, M.D. Introduction by J. B. McKnight, M.D. Ed. 2. 221 pp. St. Louis, C. V. Mosby, 1930.

The sub-title of this volume, "A Book for Tuberculous Patients, Public Health Nurses, and Doctors," really tells the whole story. By putting this book in the hands of tuberculous patients, the doctor may simplify his work. Undoubtedly the average nurse will also profit by its study. The fact that a second edition is called for in three years is evidence that the book answers a definite purpose.

**DEMONSTRATIONS OF PHYSICAL SIGNS IN CLINICAL SURGERY.** Revised and Enlarged. By Hamilton Bailey, F.R.C.S. (Eng.). Ed. 2. 286 Pages, 306 illus., some col. N. Y., Wood, 1930.

The author states, "This book, founded upon demonstrations to fourth-year students,

was designed for their use." In spite of this fact, this book should be of great value to the practicing surgeon. The perusal of this book will bring to mind many a little point that has been forgotten and overlooked in active practice. While it is elementary on the face of it, the reading of this book will well repay anyone interested in careful surgical diagnosis.

**A TEXT-BOOK OF PSYCHIATRY** for Students and Practitioners. By D. K. Henderson, M.D. (Edinb.), F.R.F.P.S. (Glas.) & R. D. Gillespie, M.D. (Glas.), D.P.M. (Lond.) Ed. 2. 536 Pages. Humphrey Milford. Oxford Univ. Press, 1930.

"A Text-Book of Psychiatry" by Dr. Henderson and Dr. Gillespie is dedicated to Adolf Meyer, of Johns Hopkins. It is interesting to note that while the authors are Englishmen, Dr. Henderson being Physician-Superintendent of the Glasgow Royal Mental Hospital and Dr. Gillespie the Physician for Psychological Medicine at Guy's Hospital, London, both of them received their training as psychiatrists in Baltimore.

The book is thorough and up to date. The omission of references to some of the more modern American books is probably an oversight, as the text shows a thorough knowledge of modern literature. It is a comprehensive and authoritative text and reference book. The subject is here authoritatively presented in reasonable format.

**PROCEDURE IN EXAMINATION OF THE LUNGS.** With Especial Reference to the Diagnosis of Tuberculosis. By Arthur F. Kraetzer, M.D. With a Foreword by James Alexander Miller, M.D. 139 Pages. N. Y., Oxford Univ. Press, 1930.

Dr. Miller says in the Foreword: "Many of our text-books have made the examination of the chest far too complicated, and Dr. Kraetzer has made a real contribution in simplifying the methods involved." Not everyone will agree with this statement, but Dr. Kraetzer's little book of 125 pages (unfortunately without an Index) thoroughly covers every phase of the examination of the lungs. Anyone feeling that this subject is not sufficiently covered in the average book on physical diagnosis will find this volume of interest and of value. Probably, it is only by the publication of enthusiastic monographs of this nature that the authors of textbooks will find it possible to get their detailed information, and it will then be their job to condense and correlate with other subjects.

The medical student of today has our sympathy if he is expected to read a book on all the phases of diagnoses and treatment on which we older men needed only to read paragraphs or chapters.

THE NERVOUS CHILD. By Hector Charles Cameron, M.A., M.D. (Cantab.), F.R.C.P. (Lond.). Ed. 4. 256 Pages, 8 Plates. Humphrey Milford, Oxford Univ. Press, 1929.

The nervous child is one of the problems of the day and every physician, be he family doctor or surgeon, faces this problem at one time or another. Therefore, the first chapter alone on "Doctors, Mothers and Children" is recommended to the attention of every medical man. This chapter in itself is well worth the price of this book.

PROGRESSIVE MEDICINE. Vol. 1, March, 1930. Phila., Lea & Febiger, 1930.

The quarterly digests of the "advances, discoveries and improvements in the medical and surgical sciences," known to many of the profession under the general title, "Progressive Medicine," are too well known and worth while to need more than a casual introduction.

The latest number (March 1930) continues the high standard of previous issues. Surgery of the head, spinal cord and peripheral nerves is covered by Francis C. Grant; surgery of the thorax, including the breast and goiter, by George P. Muller; infectious diseases, including acute rheumatism, croupous pneumonia and influenza, by H. E. MacDermot; diseases of children, by John P. Caffey; rhinology, laryngology and otology, by John A. Bacher. There is an index.

We do not intend to be hypercritical and discuss every misprint or clouded statement. However, on page 63 occurs a statement which needs correction. It reads, "No discussion of anaesthesia in cranial surgery can be considered complete without reference to the recent work of Koster on the use of spinal anaesthesia . . . the statement of Koster is important that in the last 200 laparotomies

which he performed, the entire head and face were rendered insensitive to pain . . ." This probably is a mis-statement. We have looked through Koster's writings and fail to find this statement. But we did read, "In our clinical study of complete body anaesthesia which now number over 750 cases, we have not met with serious cardiac or respiratory embarrassment."

BIOGRAPHISCHES LEXIKON der hervorragenden Ärzte aller Zeiten und Völker. Unter Spezial-Redaktion von Dr. E. Gurlt und Dr. A. Wernich herausgegeben von Dr. August Hirsch. Zweite Auflage durchgesehen und ergänzt von Prof. F. Hübner, Berlin, und Prof. H. Vierordt, Tübingen. Zweite Bd. Chavet—Gyulay. Mit 64 Bildnissen, 932 Teite. Berlin, Urban & Schwarzenberg, 1930.

The second volume of the new edition of "Hirsch's Biographisches Lexikon" is now before us and runs from "Chavet to Gyulay." Like the first volume it contains much interesting material splendidly arranged.

There are 64 illustrations on 16 plates. We feel it would be better for these portraits to be put right in with the individual biographies, even at the expense of having to use a coated paper for the whole book. If the present method is continued, however, it would seem that it would be well to have a notation at the end of the biography, stating on what page the portrait will be found. As it is now, there is no way of telling from reading the biography whether there is a portrait published and one has to turn to the list of illustrations at the beginning of the volume. This is not a serious matter, but it would seem to be very simple to put in brackets an indication that a portrait has been published.

It is to be hoped that before this set is completed, there will be a geographical list of names. It would be interesting to check up how many men from any special country have done work in medicine worthy of being included in such a work.

We look forward impatiently to the completion of this unique work which is invaluable for historical references.



A CLINICAL STUDY OF THE  
ABDOMINAL CAVITY AND PERITONEUM

EDWARD M. LIVINGSTON, M.D.

PUBLISHED SERIALY IN

*The American Journal of Surgery*

FIFTH INSTALLMENT  
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# A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM

## SECTION I. THE CAVITY

### E. INTRAPERITONEAL FLUIDS (*Continued*)\*

5. DIFFERENTIATING FREE INTRAPERITONEAL FLUIDS. Free fluids give rise to such conditions as ascites, hemoperitoneum, bile peritonitis, chylous peritonitis, urinary extravasations; and as the various liquids spread over the peritoneal membrane or accumulate to distend the abdomen, each produces a quite distinctive clinical picture.

*a. Hemoperitoneum.* With free blood, the clinical picture is composite in character; there is combined evidence of acute anemia, shock, and free intraperitoneal fluid. Among the signs and symptoms are pallor, syncope, thirst, air hunger, rapid pulse, lowered blood pressure, diminution in erythrocytes and increase in the leucocytes; nausea or vomiting occur and abdominal pain, either localized or generalized, is complained of; the flanks are dull, but the shift in the line of dullness occurs in a manner which is unusually sluggish; rarely, a boggy, localized palpable mass is present within the abdomen.

Factors Favoring  
Bleeding

Hemoperitoneum results from direct penetrating abdominal wounds or the rupture of some intra-abdominal organ or vessel (ectopic gestation, ruptured lutein hematoma, perforation of bowel, aneurysm). Conditions in the abdomen favor a continuation of bleeding. The vessels (gastric, intestinal, mesenteric, omental, prevertebral trunks) lie in loose tissues; there is little resistance to the flow of blood into the cavity and fatal hemorrhage may arise from a surprisingly small point. Wounds or ruptures of liver and spleen bleed very rapidly, due to the vascularity and structure of these organs. More or less

\* Previous installments of this book appeared as follows: January issue, p. 193; February issue, p. 459; March issue, p. 693; April issue, p. 912.

clearly defined masses, dull to percussion, sometimes form when the blood accumulates in limited regions (below the right lobe of the liver, about the spleen, in the lesser sac,

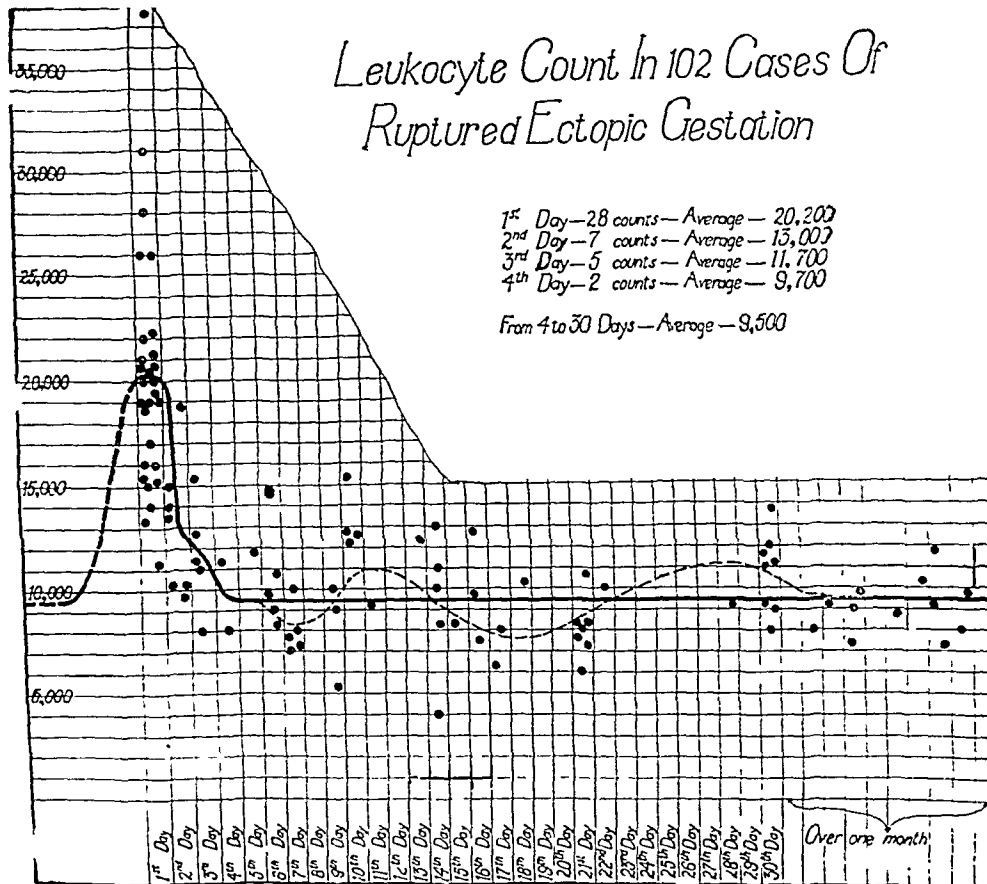


FIG. 68A.

The leucocytosis of subserous hemorrhage. (From Wright and Livingston.)

in the pelvis, within the retroperitoneal tissues). When the bleeding is of gastrointestinal origin hematemesis or melena may indicate the diagnosis.

The leucocytic curve after intraperitoneal, as after any subserous bleeding is typical.<sup>82</sup> This is a very important curve, for it occurs with conditions which may readily be mistaken for acute sepsis. The peak of the curve (200–300 per cent rise) is reached in eight hours (Fig. 68b). Hence consecutive counts within this early period show a rapidly rising leucocytosis

Leucocytosis from  
Subserous  
Hemorrhage

# The Leukocytosis Of Intraperitoneal Hemorrhage (5: Experimental Chart No. Three)

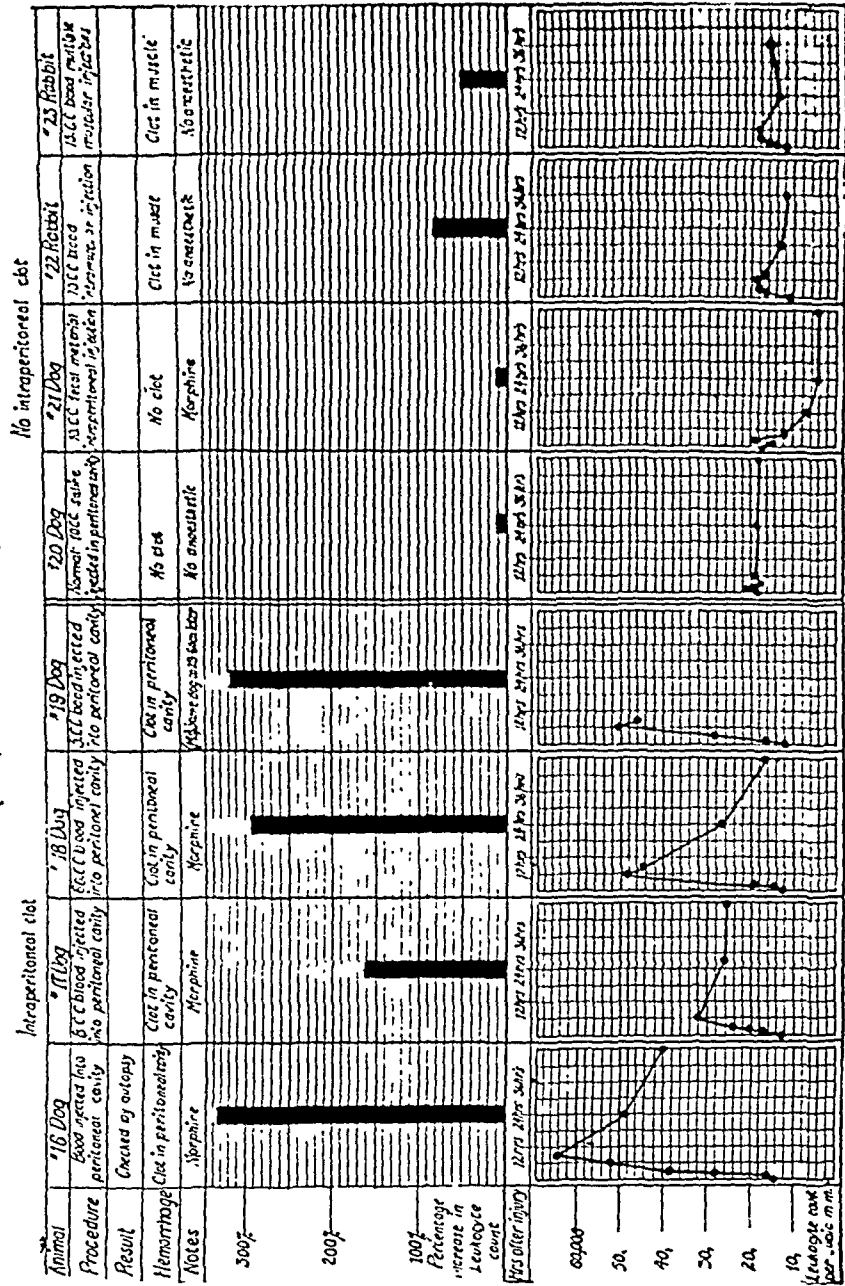


Fig. 68n.  
The leucoctosis of subserous hemorrhage. (From Wright and Livingston.)

which may reach such figures as 30,000 or even 40,000 (Fig. 68a). From this early peak the count returns slowly to normal, which is reached by the fourth day unless new hemorrhages occur. The polymorphonuclear cells are both relatively and absolutely increased. This typical blood curve is unaffected by the quantity of intraperitoneal leakage or by the prompt removal of the clotted and fluid blood from the peritoneal cavity. Bleeding outside of serous cavities, regardless of the amount of blood extravasated, does not give rise to similarly marked leucocytic reactions; i.e., 2 c.c. of blood within the peritoneal cavity may produce a leucocyte rise of over 200 per cent while 200 c.c. of blood throughout the muscular and fascial planes will not double the normal count. This "leucocytosis with internal hemorrhage" is not to be confused with the so-called "leucocytosis following hemorrhage." The latter is the late, slight (20-50 per cent) leucocytic rise, which follows a severe loss of blood from the body. This compensatory leucocytosis does not reach its peak until the fourth day.

*b. Bile Peritonitis (Choleperitoneum).* The clinical picture with the intraperitoneal leakage of bile is that of a mild peritonitis: pain, nausea or vomiting, slight fever, distention. Rigidity is absent or slight after the initial invasion. Slight jaundice may be noted. The detection of bile in the urine or blood serum constitutes an even more delicate test than the observation of scleral discoloration. Free bile accumulates rapidly and all of the signs and symptoms mentioned in discussing the evidences of moderate amounts of free intraperitoneal fluids may be found upon examination. The bile soon becomes mixed with such serous or serofibrinous fluid as is thrown out by the peritoneum after any chemical or mechanical injury; unless infected, no pus will form. With infected bile the picture is changed to that of a severe pyogenic peritonitis.

Sterile Peritonitis

The bile may originate from the gall bladder, liver, biliary ducts, or even from the duodenum. Such leakage follows injuries (stab wounds), accidents (slipping of cystic duct

ligature after cholecystectomy) or occurs as a complication of biliary diseases (gangrene of gall bladder; erosion from stone). Although bile is very toxic and irritating when free within the peritoneal cavity, so far as the bile peritonitis alone is concerned the patient may be expected to recover if adequate surgical drainage is promptly established.

*c. Chylous Ascites* (Chylous peritonitis.) This is due to injury or blockage of the main abdominal lymphatics, particularly the receptaculum chyli and thoracic duct. The condition is characterized by (1) the very rapid accumulation of a large volume of milky or yellowish-white intraperitoneal fluid containing many fat globules but few cellular elements, and (2) the clinical picture of starvation and rapid emaciation. The fluid is identified as chyle only by microscopical and chemical examinations.

When there are symptoms of a disease in the neighborhood of the stomach, associated with extreme emaciation, free intraperitoneal liquid, and a tendency to copious, pale and fluid stools, a diagnosis of obliteration or rupture of the thoracic duct should be considered. Exact diagnosis depends upon study of the free fluid and the nature of the underlying lesion is usually conjectural until the time of operation or necropsy. The most common causes of chylous ascites are direct injury, filarial infection, or duct obstruction from malignant or other tumors (tuberculous glands). Fracture of the tenth thoracic vertebra has been responsible for the condition. It may also arise, the exact reason being uncertain, with the peritonitis sometimes associated with Bright's disease and leucemia. Although chylous ascites usually leads rapidly to death (70 per cent mortality), spontaneous absorption and cure have been known to occur.<sup>83</sup>

An accumulation of chyle within a hernial sac is termed a chylocele; chylous ascites has been discovered as a result of the laboratory examination of fluid aspirated from a chylocele.

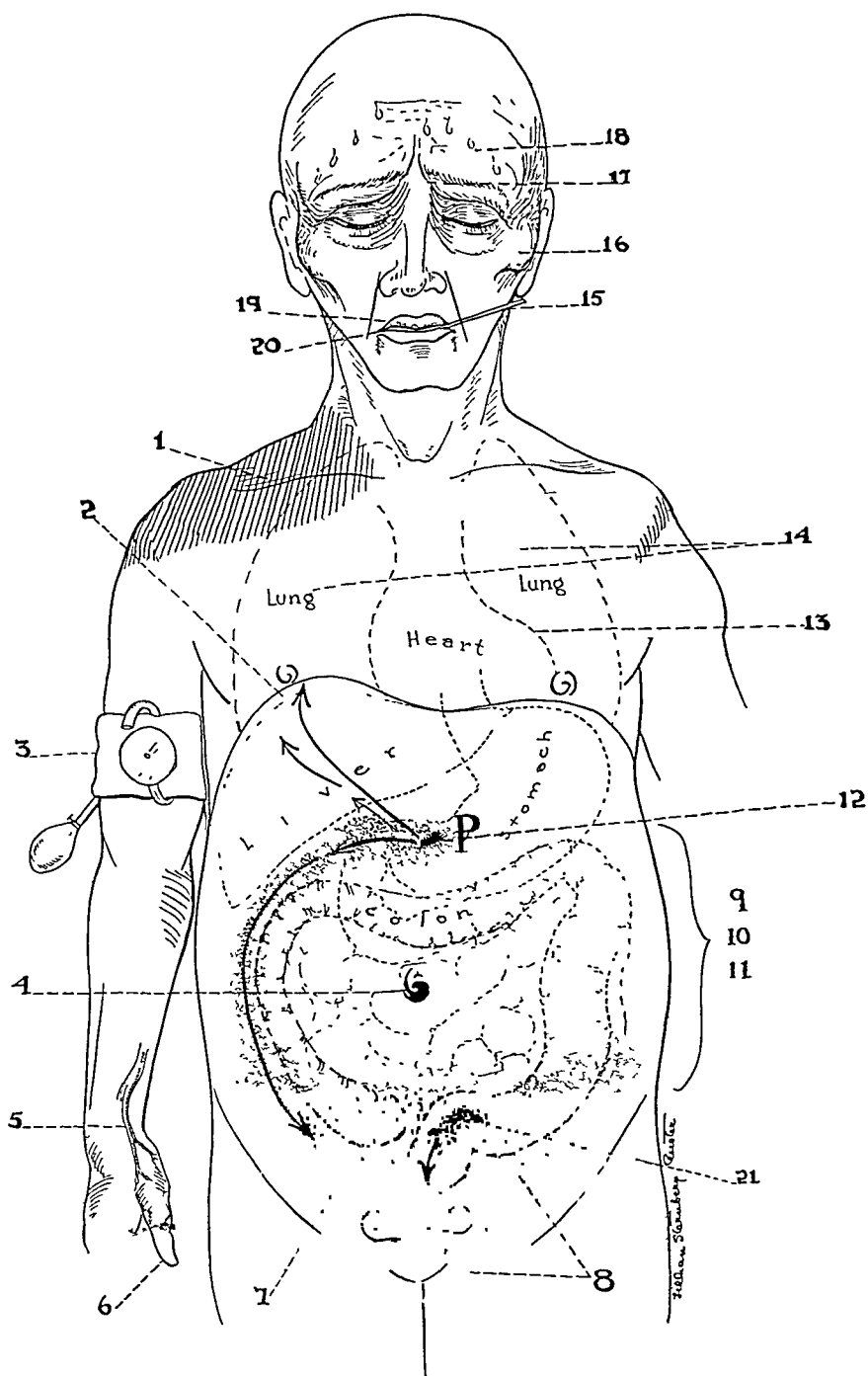


FIG. 69. Graphic study of some signs and symptoms caused by intestinal perforation.

1, Shoulder pain. 2, Free gas, obliterated liver dullness. 3, Altered blood pressure. 4, Umbilical pain. 5, Rapid pulse. 6, Blood count. 7, Free fluid. 8, Occult blood. 9, 10, 11, Tenderness, rigidity, dissolution of abdomen. 12, Epigastric pain. 13, Caped heart. 14, Dyspnea. 15, Subnormal temperature. 16, Pallor. 17, Pinched expression. 18, Perspiration. 19, Hiccough. 20, Vomiting. 21, Clotted blood in rectum.

#### Chylous vs. Chyliform Ascites

True chylous ascites is to be differentiated from pseudo-chylous or chyliform ascites in which a primarily ascitic fluid takes on a milky appearance from little understood chemical changes. Chyliform ascites is more common than true chylous ascites and the conditions must be distinguished by chemical and microscopic study of the fluid.

*d. Free Enteral Contents.* The clinical picture caused by intraperitoneal leakage of gastric and intestinal contents has already been discussed (see traumatic rupture of the small bowel). (See also Fig. 69.) Pneumoperitoneum and hemoperitoneum are often simultaneously present. The inability to demonstrate free fluid, however, is often a fallacious guide and should lead to no delay in operation when other evidence justifies the diagnosis of gastrointestinal perforation, since perforations are uniformly fatal unless treated by operation and each hour of delay adds to the risk. A particularly deceptive part of the clinical picture is the apparent well-being of the patient for a short period after the initial shock from the perforation has passed off.

*e. Intraperitoneal Urinary Extravasation.* This may result from injuries to the kidney, ureter or urinary bladder, the latter being the most common site. Bladder rupture is by no means frequent (encountered in 1 in 3000 general surgical cases) but the high mortality of this accident justifies its careful study (30 to 80 per cent mortality even under the most favorable conditions).<sup>81</sup>

The full bladder is an abdominal organ exposed to injuries (Fig. 70) while the empty bladder is a pelvic structure, protected and collapsed. Bladder rupture is always due to trauma, but the accident is favored by vesical distention, alcoholism and preexisting diseases of the vesical walls; it is often observed with fractures of the pelvis (25 per cent of patients with pelvic fractures suffer simultaneous bladder injuries). Ninety per cent of cases of bladder rupture occur in males, due to the more violent nature of their activities, also to the greater depth of the female pelvis and the interposition of the uterus between

bladder and vertebral column. The true diagnosis is often ascertained only at operation since patients suffering from rupture of the bladder are frequently in shock when first

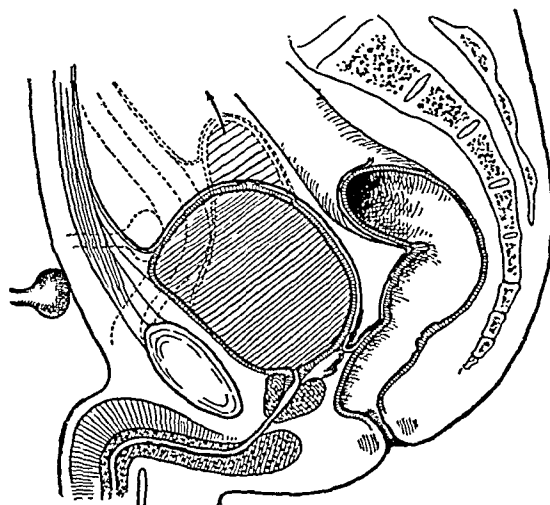


FIG. 70. Mechanism of rupture when bladder is full and trauma is in anteroposterior direction. Intraperitoneal rupture usually occurs. (After Rouvillois and Ferron, from Campbell in *Surg. Gynec. Obst.*)

seen and but a poor history is obtainable. The evidence is usually that of rupture of some viscus and the peritoneal cavity at operation is found filled with fluid having the typical appearance and odor of urine; the bladder rent is then discovered. Preoperative evidence of bladder injury, however, includes the following: inability to void, dysuria, hematuria, exquisite local bladder tenderness, a positive catheter test (more urine drained away than could have been held within the nondistended bladder, the fluid coming back through the bladder rent from the urine-filled peritoneal cavity; more sterile solution introduced through the catheter than could be held by the bladder alone. Further preoperative evidence is furnished by a positive vesical pneumoroentgenogram (150–100 c.c. of air are injected into the bladder and roentgenograms taken; if air has passed into the peritoneal cavity it reaches the subphrenic area and pneumoperitoneum is in evidence; if it reaches the retroperitoneal spaces air crepitus may be made out and the roentgenogram shows the distribution of the air; while if the



air remains within the intact bladder the film demonstrates this fact). Again the cystoscope may reveal the rent. If the extravasation is actually intraperitoneal the symptoms are those of an irritative peritonitis. As a rule the condition of the patient does not warrant prolonged study and the possibility of associated intra-abdominal injuries (ruptures of spleen, intestine, kidney) favors prompt exploration. To await the recovery from primary shock is generally viewed as unwise since the typical course without operative intervention is a progressive and rapid decline, with prompt death. Death is due to hemorrhage, shock, associated injuries, peritonitis.

*f. Ascites.* The fluid most frequently found free within the peritoneal cavity is that thin, serous, or watery substance which characterizes the condition known as true ascites, abdominal dropsy or hydroperitoneum. The causes of ascites have been classified by French as follows:<sup>85</sup>

(1) *Disease of the Peritoneum:*

Non-suppurative acute peritonitis

"Simple" chronic peritonitis

Tuberculous peritonitis

Malignant peritonitis, generally secondary to a primary growth elsewhere

Hydatid cysts in the peritoneal cavity.

(2) *Obstruction to the Main Portal Vein by:*

Non-suppurative thrombosis

Enlarged portal lymphatic glands:

Malignant

Tuberculous

Lymphadenomatous

Lymphatic leucemic

Tumors of adjacent organs, such as:

Liver

Duodenum

Pancreas

Colon

Kidney

Suprarenal capsule

Stomach

Rarities such as aneurysm of the hepatic artery.

(3) *Diseases of the Liver:*

Cirrhosis

Perihepatitis, really part of chronic simple peritonitis

Carcinoma Sarcoma Syphilis Hydatid disease	}	Doubtful causes if the lesions are confined to the liver; i.e., if there is ascites, it is probably not due to the carcinoma, etc., in the liver, but to simultaneous affection either of the peritoneum or of the portal lymphatic glands.
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(4) *Obstruction of the Inferior Vena Cava above the Hepatic Veins*  
by:

Thrombosis  
 Chronic mediastinitis  
 Mediastinal growth.

(5) *Chronic Failure of the Right Heart* ("backward pressure") the result of:

Valvular disease:  
 Mitral stenosis  
 Mitral regurgitation  
 Aortic stenosis or regurgitation with secondary mitral regurgitation:  
   Rheumatic or syphilitic  
 Congenital pulmonary stenosis (rarely)

Chronic myocardial affections:

Fatty degeneration	Fibroid heart
Fatty infiltration	Primary alcoholic heart
Fatty superposition	
Adherent pericardium	

Chronic lung affections, especially:

Emphysema Recurrent bronchitis Fibroid lung	}	Generally associated
---	---	----------------------

Chronic high blood pressure:

Red granular contracted kidneys  
 Pale granular contracted kidneys  
 Arteriosclerosis.

(6) *Bright's Disease*. In Bright's disease ascites may be caused in at least four different ways, namely, as the result of:

Part of a general dropsy

Acute peritonitis

Chronic peritonitis

Secondary to hypertrophy and dilatation of the heart, followed by failure of compensation.

(7) *Severe Anemias*, in which the ascites is usually the result of acute, subacute, or chronic intercurrent peritonitis, as in:

Splenomedullary leucemia

Splenic anemia

Lymphatic leucemia

Pernicious anemia

Hodgkin's disease

Aplastic anemia

Pseudo-leucemia infantum

Malaria.

6. A CLINICAL CONSIDERATION OF ASCITES. Ascites is always of serious import. This holds true whether the cause be medical or surgical, local or general. The condition implies either an extensive irritation of the peritoneal membrane itself or a severe interference with the circulatory system. The most common cause of ascites is heart disease; next in order come renal affections. The chief local or intra-abdominal causes are: (1) cirrhosis of the liver, (2) tuberculous peritonitis, (3) malignant peritonitis, and (4) other tumefactions which press upon the great vessels.

*a. Ascites Due to Cardiac Disorders.* Swelling and edema of the legs almost always precede the abdominal dropsy; the ascites is but part of a generalized edema which may include even the abdominal walls. The right heart is most often involved; the liberation of free fluid is due to a backpressure in the vessels (a transudate). A history of rheumatism is frequently obtained and the physical signs of mitral disease observed. The cardiac origin of the ascites is further indicated by irregular and rapid pulse, dyspnea or orthopnea, cardiac enlargement, precordial distress, enlarged and often pulsating liver. Forty per cent of cases showing a quart or more of ascitic fluid at autopsy have had heart disease as the cause of the ascitic accumulation.<sup>86</sup>

*b. Ascites Due to Renal Disorders.* The usual condition present is chronic parenchymatous nephritis or Bright's disease. In this condition the ascitic fluid is but part of a general anasarca and it is proportionate to the accumulation of fluids throughout the subcutaneous tissues. The urinary findings include a scanty output, albumin and casts. Kidney function is found to be lowered and the blood urea high. Albuminuric retinitis may be present. Pouches are to be seen beneath the eyes; the patient may complain of headache, nausea or vomiting. The arterial tension is raised with accentuation of the aortic second sound. Cardiac and arterial disorders (myocarditis, arteriosclerosis) often coexist with the renal disorder.

*c. Ascites Due to Severe Anemias.* The hydroperitoneum occurs late in the course of the disease at a time when the diagnosis has as a rule already been established through the blood picture and associated evidence.

*d. Ascites from Cirrhosis of the Liver.* With cirrhosis ascites is a late manifestation. There is usually a history of alcoholism, hematemesis, melena, dyspepsia, jaundice. The spleen is frequently palpable. The patient has an hepatic facies. Dilated venules may be seen along the hepatic margins and over the abdominal wall.

*e. Ascites with Tuberculosis of the Peritoneum.* This may occur at any age; the greatest number of cases are found in the second and third decades of life. Tuberculosis is the most common cause of hydroperitoneum in children and in young women. Tuberculous peritonitis is usually secondary to tuberculous lesions elsewhere, notably in lymph glands, joints, bones or kidneys: the majority of cases are due to the bovine type of organism. A family history of tuberculosis is suggestive evidence and a personal history of a cervical adenopathy, pleurisy with effusion, chronic bone or joint disease or the discovery of a concomitant tuberculous lesion constitutes strong presumptive evidence that the ascites is excited by the tubercle bacillus. Aside from the involvement of the peritoneal

cavity as a part of a miliary tuberculosis, the following three varieties of tuberculous peritonitis are recognized: (1) the ascitic form, (2) the locular form, and (3) the fibroadhesive form. Of these the first variety is characterized by the presence of free fluid (68 per cent) and the second by encapsulated fluid (23 per cent). The condition may be symptom-free and be only accidentally discovered at operation or autopsy, but more commonly there are vague gastrointestinal complaints (anorexia, constipation alternating with diarrhea, nausea, irregular colics and pains throughout the abdomen), often associated with clinical evidences of infection by the tubercle bacillus (afternoon temperature, night sweats, general malaise). The physical signs are those of free or encapsulated intraperitoneal fluid with or without associated indefinite nodular or patchy masses throughout the belly. The abdomen may have a typically doughy feeling, that is, yield a sensation of boggy resistance. The infiltrated and chronically inflamed omentum and mesentery are shortened and retracted. The omentum itself tends to be pulled upward into a thickened roll lying transverse to the long axis of the cavity and somewhat to the left of the midline along its attachment to the transverse colon and greater gastric curvature; this often is plainly felt through the abdominal wall.

Ascites from  
Chronic Peritoneal  
Inflammations

Toma's sign, intended as a test in differentiating between inflammatory and non-inflammatory ascites, is based upon the shortening of the mesentery with chronic inflammations, drawing the intestinal loops to the right side of the abdominal cavity; as the patient lies upon his back there is tympany on the right (clumping of loops of small bowel) and dullness on the left (ascitic fluid) (Fig. 71). With non-inflammatory ascites, the intestines being unretracted, the distribution of the fluid is more uniform and the intestinal coils tend to float to a central location. The umbilicus, though normal in most instances, will bulge if the fluid becomes great in quantity, be thickened when multiple miliary or conglomerate tubercles exist at this point, be reddened or dusky with chronic conges-

tion due to rerouting of venous blood when there is a partial obstruction to the central vessels, or be the site of peritoneal or intestinal fistula formation from spontaneous rupture

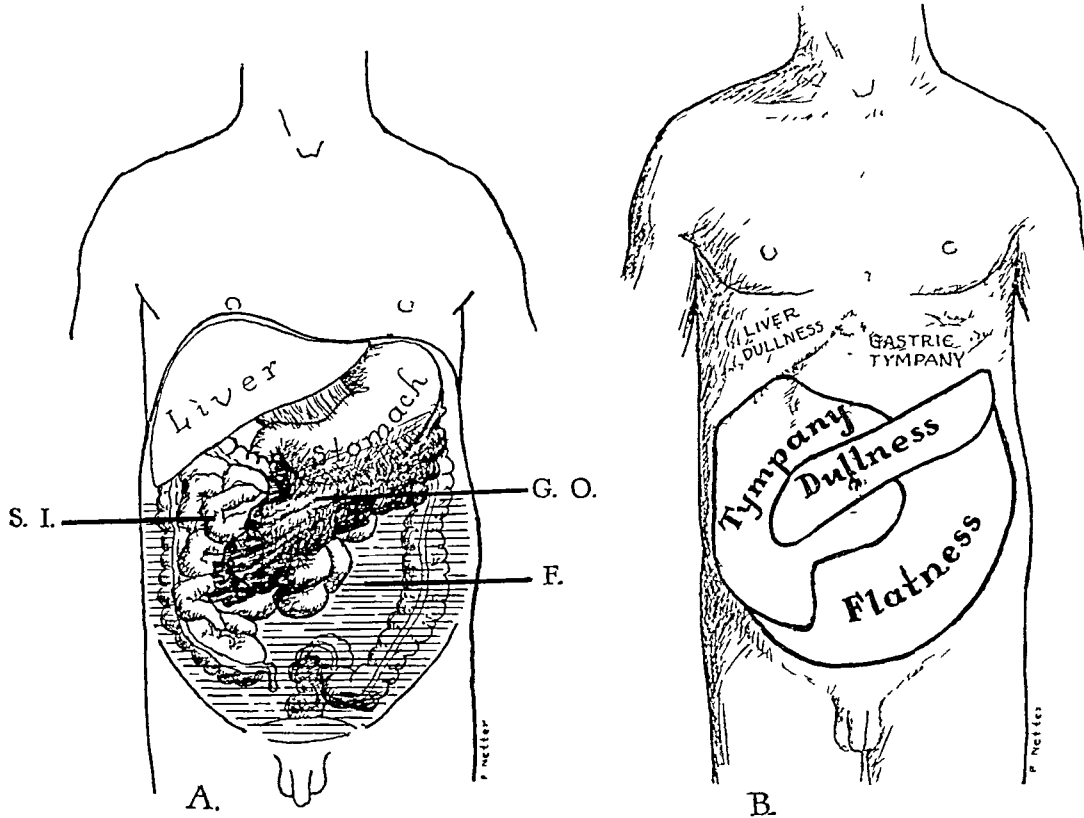


FIG. 71. Ascites due to chronic inflammation of the peritoneal membrane.

A. Showing retraction of mesentery pulling coils of small intestine upwards and to the right; retraction of great omentum forming a transverse roll or mass; free fluid fills the left lower quadrant and pelvis.

B. Showing signs obtained by percussion, tympany on the right and dullness or flatness on the left with the patient lying flat on the back. S. I. Small Intestine. G. O. Great omentum. F. Fluid.

occurring at this weakest and thinnest point in the abdominal walls.

The diagnosis of tuberculous peritonitis, made upon the presumptive evidence of the history and physical findings, may be established by the microscopical examination of excised pathological tissue, by seeing the typical miliary tubercles at operation or by guinea-pig inoculation of the intra-peritoneal fluid.

*f. Ascites with Malignant Peritonitis.* Cancerous disease of the peritoneum usually occurs in patients over forty; the quantity of fluid may be large and as a rule is blood stained;

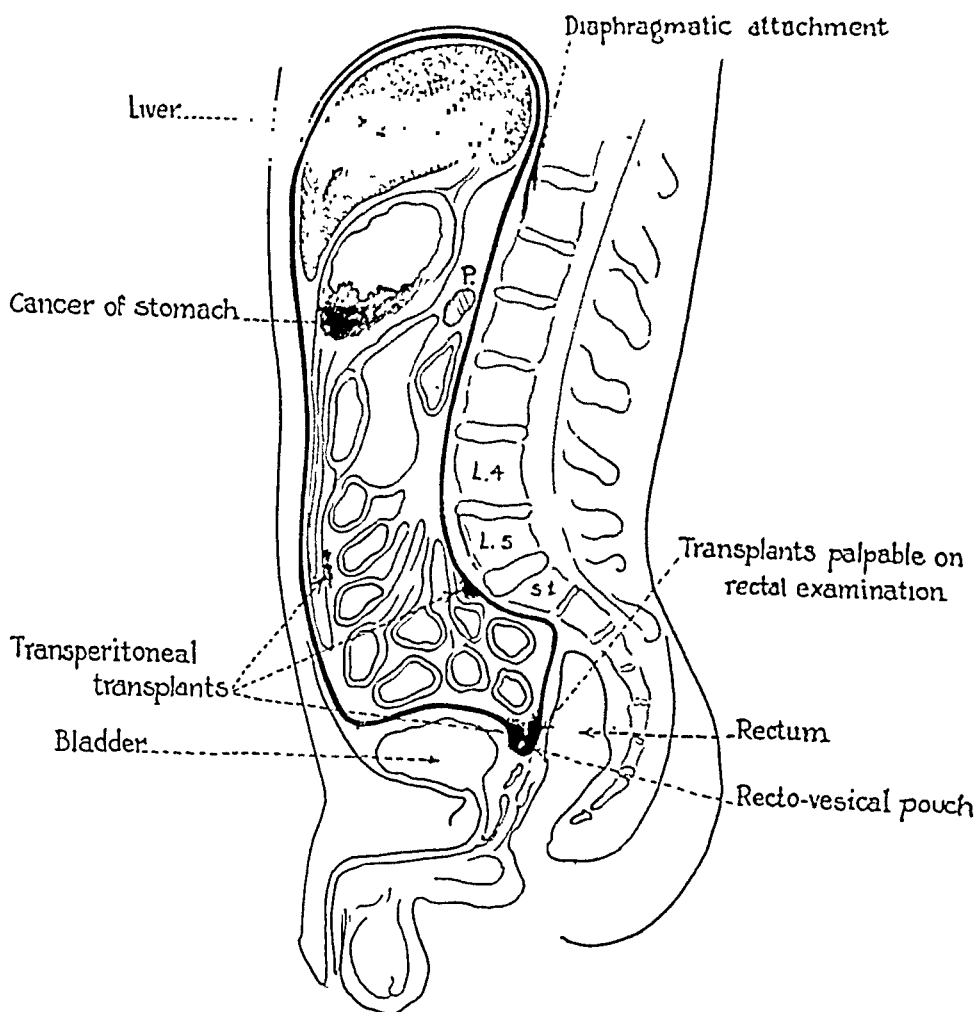


FIG. 72. Transcelomic malignant transplants, showing nodules of malignant tissue which have gravitated to the lowest portions of the peritoneal cavity and may be palpated through the rectal wall.

rapid emaciation and cachexia are the rule. Multiple nodules of characteristic consistency are frequently palpable; these may exist at any point but a favorite site is at the umbilicus where the disease has spread through extension along the falciform or round ligaments of the liver, the urachus or the obliterated

hypogastric arteries (lateral umbilical ligaments). Gravity plays a part in the transcelomic implantation of free cell clusters, thus frequent sites are the perirectal reflections of peritoneum, (causing firm nodules palpable through the rectal wall), the tunica vaginalis (giving rise to irreducible scrotal masses associated with a reducible or irreducible inguinal hernia); and the ovaries, which often lie upon the most dependent pouches of peritoneum. (See Fig. 72.) Primary cancer of the peritoneum is rare; the primary nodules which cause the secondary peritonitis should be sought, especially in the stomach, rectum, breast, uterus, ovaries, prostate and pancreas. Rectal digital and sigmoidoscopic examinations should routinely be made and the vaginal examination should not be omitted in the female. Enlarged lymph glands: pubic, inguinal superficial abdominal, supraclavicular (the so-called Virchow-Troisier gland on the left side) may be studied microscopically for the identification of the type of tissue of the primary growth. The worn, drawn, anxious facies, and the emaciation about the head, chest and upper extremities, associated in the middle-aged patient with a protuberant belly containing multiple hard nodules, present a quite typical clinical picture.

The Virchow-Troisier Glands

g. *Ascites from Pressure upon Abdominal Vessels.* In addition to the tumefactions of malignant and tuberculous peritonitis there are numerous other swellings and growths which produce back pressure in the great veins of the abdomen (the iliac and hepatic veins; the portal vein and its important radicals; the inferior vena cava). Among these are carcinomata of the liver, pancreas, and biliary adnexa; enlarged lymph glands, Hodgkin's disease, etc.; ecchynococcus cysts; retroperitoneal carcinomata or teratomata. These conditions are individually studied elsewhere. There is little that is characteristic about the ascites which they produce and the diagnosis usually is arrived at only by exclusion or is not made with precision until the time of operation or post-mortem examination.



*General Clinical Rules.* The following represent a few broad generalizations relative to ascites and the differentiation of its many causes.<sup>87-90</sup>

When edema and swelling of the legs precede the onset of ascites, heart failure is the most likely cause of the condition.

Ascites which is but part of a general anasarca with involvement not only of the abdomen and lower extremities, but also of the other body cavities, upper extremities, face, and even scalp, is generally due to renal disorders, notably acute Bright's disease. General edema associated with albuminuria points to renal disease as the cause of the ascites.

If jaundice is associated with ascites it points to some form of portal obstruction as the cause (most often to cirrhosis or malignancy of the liver).

If ascites is the only fluid accumulation present in the patient, if, although there is also swelling and edema of the legs, the ascites is known to have appeared first, or if the ascites is out of proportion to dropsy elsewhere, it is almost certainly due to some local or intra-abdominal cause, either some form of peritonitis, portal obstruction by a thrombus, pressure on the portal vein, or to cirrhosis of the liver.

If jaundice coexists, a slight degree suggests cirrhosis of the liver, an intense jaundice, malignancy.

A history or the manifestations of syphilis point to this form of liver affection; a history or evidences of alcoholism point to cirrhosis.

An ascites which has recurred after repeated tapplings may be due to cirrhosis of the liver but is most often due to chronic hypertrophic peritonitis.

Ascites associated with multiple abdominal tumors suggests tuberculous or malignant peritonitis.

The evidence of a malignant growth elsewhere makes the diagnosis of malignant peritonitis almost certain.

Enlarged glands above the left clavicle point to malignant disease.

<sup>87</sup> A. J. S., n. s. Vol. VIII, No. 5, p. 1126

In children and young women tuberculous peritonitis is most common; in males over forty cirrhosis of the liver, chronic peritonitis, and cancer should first be thought of.

Persistent fever, the presence of old scars in the neck, or a concomitant pleurisy or known tuberculous lesion make tuberculous peritonitis the probable cause of the ascites.

#### F. PRESSURE VARIATIONS WITHIN THE ABDOMEN

The expression intra-abdominal pressure is frequently encountered in surgical literature. The term is routinely employed in discussions on peritonitis, ascites, pneumoperitoneum, visceroptosis and intestinal obstruction. But no matter how casually intra-abdominal pressure is referred to, there always remains a certain vagueness as to the precise meaning of the term and specific figures as to the actual pressure or pressures present are difficult to find. The statement may be read that intra-abdominal pressure is always negative.<sup>91</sup> Similarly dogmatic assertions may be found that it is always positive.<sup>92</sup> At times it is recorded that a negative and a positive pressure simultaneously exist within the abdomen;<sup>93</sup> at others it is written that such coexisting differences in pressure within a single space are obviously impossible. In general, the impression seems widespread (because of a similarity of terms) that intra-abdominal pressure, in some indefinite way, is analagous in meaning to the well-understood term intrathoracic pressure.

Confusion concerning Pressures

This ill-defined status of the subject may be explained by the fact that pressures within the abdomen depend upon many factors. Intra-abdominal pressure, as will later be made apparent, represents a complicated problem. The forces at work are numerous; and the combinations and inter-reactions of these forces are complex. Since the pressures themselves are variable it is not surprising that statements concerning them should also vary. Even the interpretation of manometer readings, because of the variables, proves a difficult matter. Authors in describing conditions which prevail within limited regions of the abdomen or which exist in prescribed circumstances have, at times, so extended their

The Variables

statements and so generalized, that considerable confusing and conflicting data have accumulated. As is the case with any problem involving variables, accuracy is attained only as each variable factor is taken into consideration; generalizations prove misleading.

The Clinician's  
Interest in Pres-  
sures

The present aim in studying pressure conditions within the abdomen is to deal solely with clinical aspects of the subject. It seems essential that the clinician attempt some correlation of the conflicting statements of surgical literature. In order to recognize pathological increases or decreases in pressures and to search intelligently for their causes, a clear understanding is requisite of what constitutes the normal. Effective treatment as well as accurate diagnosis is dependent upon a thorough knowledge of the forces at work.

Methods for Study

In contrast to the frequency with which this term intra-abdominal pressure appears in surgical writings, little or no reference to the subject is found in textbooks on physiology. These source books on human function offer little aid. While they uniformly define and describe intrathoracic pressure, they give no similar definitions or discussions on intra-abdominal pressure. The subject must be studied, then, first, through a comparison of abdomen and thorax and, second, through an analysis of certain well-understood clinical observations.

*Intrathoracic Pressure.* Within the pleural cavities the pressure is subatmospheric. This relative negativity is said to be developmental in origin, arising from the more rapid growth of the chest wall than of the lung tissue and from the down-growth during embryonic life of the diaphragm. This negative pressure is maintained by the rigid walls of the thorax which prevent the atmosphere from forcing the parietes inward to equalize pressures within and without.<sup>34</sup> If the ribs are removed or the chest opened, the negativity is diminished or equalized and the lungs collapse, due to their elasticity. During normal inspiration the thoracic cage is enlarged, increasing the relative negativity within the pleural cavity, and the outside pressure then forces air into the lungs until the limits of their distensibility are reached (Fig. 73). During the expiratory phase of the

respiratory cycle the weight of the chest (gravity) and the elasticity of the lungs (tension), combine to force the tidal air outward.

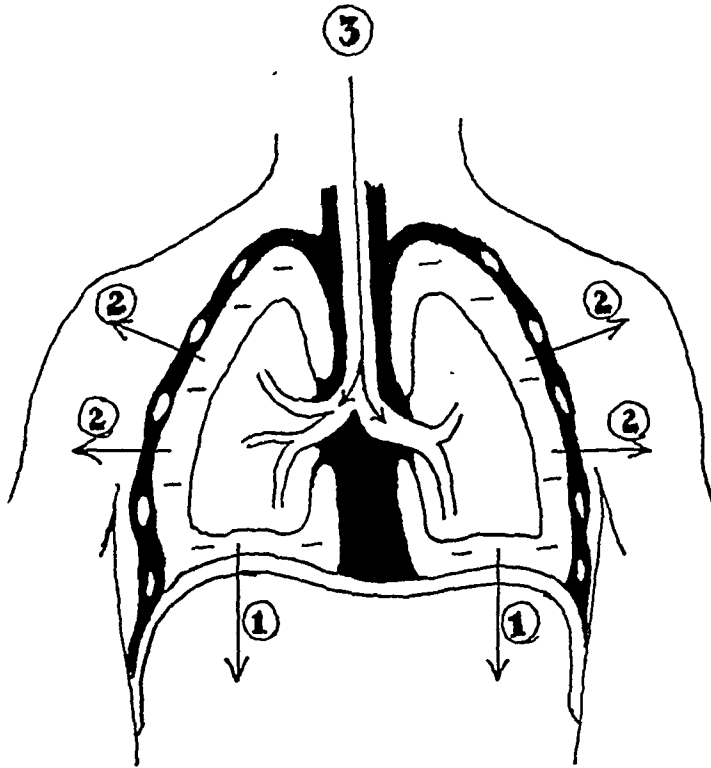


FIG. 73. Intrapleural negativity. The subatmospheric pressure within the potential pleural cavities is increased (greater negativity) as the diaphragm (1) moves downward and as the thoracic cage (2) is further enlarged by movements of the intercostal muscles and ribs; air is then forced into the lungs (3) by the pressure of the atmosphere.

It must be obvious that within the abdomen no similar marked and generalized negativity is possible, for the abdominal walls are muscular and contain no bony framework capable of resisting the force of the atmosphere. As pointed out, the definitions of the word chest (a box) and belly (a bag) imply fundamental differences in structure and behavior of the upper and the lower portions of the body wall. *Normally, then, the general pressure within the abdomen must tend to equal rather than to be above or below that of the atmosphere; the muscular wall must tend to be driven passively inward when outside pressure is the greater (scaphoid abdomen) and*

The Non-rigid  
Walls of the  
Abdomen

## Muscular Tonicity

to be driven outward when inside pressure is greater (abdominal distention from fat, fluids, flatus, feces, fetuses: see preceding chapter). Yet the problem does not end here, for the muscular walls are not simply passive structures but possess tonicity; the walls are not only acted upon by pressures, but through alterations in their tonicity they may themselves play an important part in *producing* pressure-changes; the muscles are in reflex connection with many parts of the body and by reflex contractions, pressures are increased (cough) and by reflex relaxations, pressures may be relieved (see enteroabdominal reflex); the muscles of the abdomen (those of the roof, floor and walls) may act in unison, or separate muscle groups may act separately, some being opposed to others. Again, gravity plays an important role in determining local pressure conditions; the cavity is filled with organs having various and varying specific gravities, and these viscera press with varying degrees of force (static pressure) in various regions; body posture plays a part in determining where and how such static pressures will be exerted (a state of affairs which does not exist within the thorax). Still again, the hollow organs (bladder, stomach, intestines) possess intrinsic pressures of their own (intraluminary or intravisceral pressures); and any pressure change at one point in the abdomen must immediately be compensated for by resultant or secondary changes elsewhere (Fig. 74). It is apparent, then, that the problem of intra-abdominal pressure is by no means simple. The term may mean much or little and be used accurately or erroneously, according to the care with which the constantly changing intra-abdominal conditions are interpreted.

Static Pressures  
(Gravity)Intraluminary  
Pressures

Adhering to the practical purpose of discussing only clinical aspects of the subject, attention will be directed to some of the individual forces at work.

I. EFFECTS OF THE MUSCULAR WALLS. The distensibility of the abdominal walls proves to be a compensatory mechanism of great value. Since the cavity can enlarge, any actual pressure-

increase within may be delayed, diminished or prevented. When a plaster-of-Paris jacket has been applied around the abdomen, doing away with distensibility, any marked increase

The Plaster Jacket  
and the "Dinner-  
Pad"



FIG. 74. Showing abdomen completely filled with viscera. Any pressure change at one point must be compensated for by an immediate resultant or secondary change elsewhere within the cavity. (From Edinburgh Stereoscopic Anatomy).

in intra-abdominal pressure is quickly followed by severe and alarming symptoms.<sup>95</sup> These are chiefly due to an interference with respirations through upward displacement of the diaphragm and to circulatory embarrassment through displacement of the heart or interference with the supply of venous blood returning through the inferior vena cava. It is well-known, clinically, that in applying a plaster jacket ample space must be left over the anterior abdominal wall, if these unpleasant and dangerous sequelae are to be avoided (Fig. 75). Such a space is created by placing a so-called "dinner-pad" of folded towels over the anterior abdominal wall as the plaster is applied and subsequently removing the towels from the lower margin of the cast, thus leaving a space between jacket and

skin. This pad may be omitted if the patient has partaken of a hearty meal just before the coat is applied.

Not only are alarming symptoms sometimes caused by

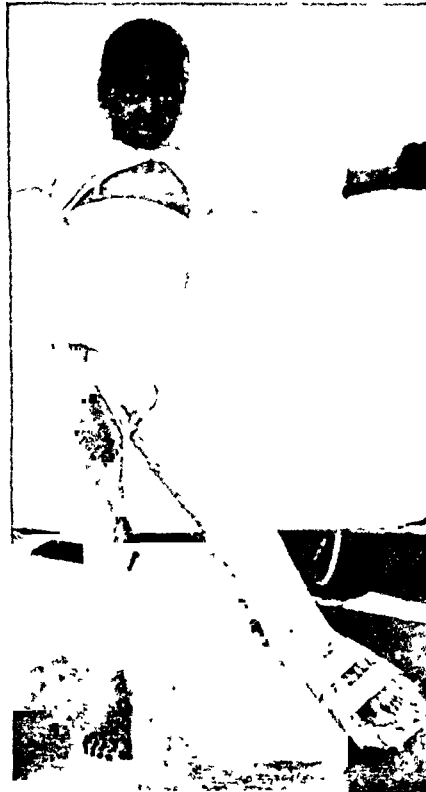
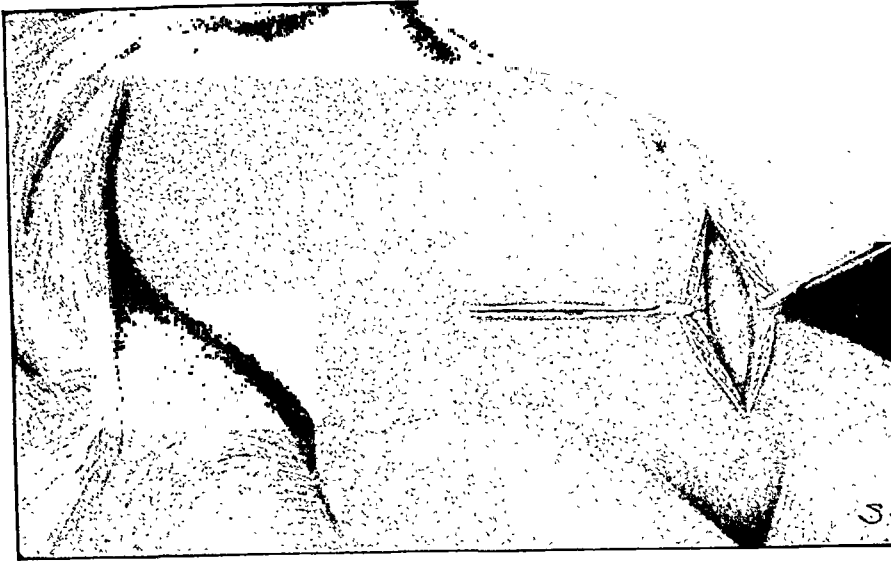


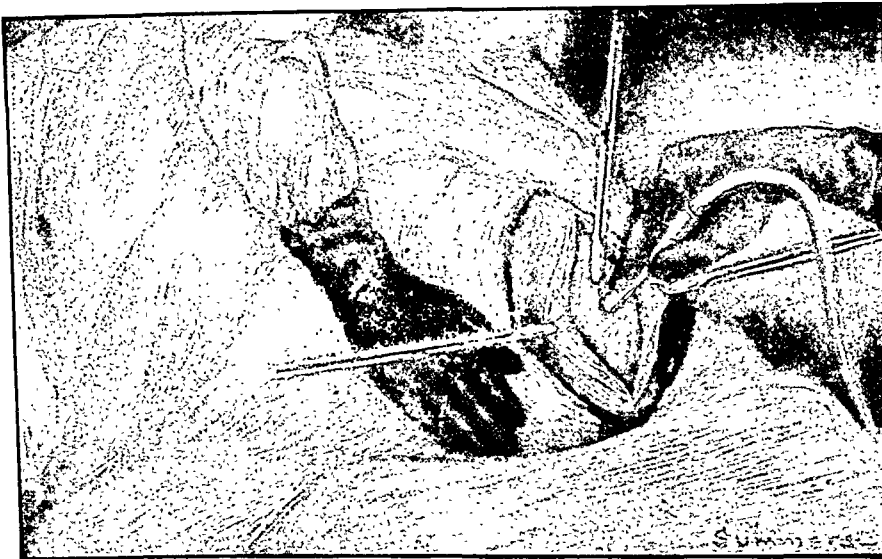
FIG. 75. Abduction plaster-of-Paris splint. Note the soft pad situated beneath the plaster over the anterior abdominal wall. (From Moorhead's Traumatic Surgery, Saunders.)

#### The Sudden Release of Intra-abdominal Pressure

marked increases in the general intra-abdominal pressure but dangerous results may also attend the too sudden release of such an increased pressure, particularly where this has been of long duration. Thus the drainage or removal of a large ovarian cyst may suddenly be followed by an overfilling of the relaxed abdominal veins with consequent partial emptying of the heart, followed by cardiac failure. To avoid this accident, an assistant should be assigned during the operation, to the task of maintaining direct pressure upon the abdominal walls.<sup>96</sup> To this end the assistant, with his hands spread out, should firmly



A



B

FIG. 76.

A. Location and length of the incision for tapping the cyst immediately before removal. Such tapping is occasionally advisable, in cases where the tumor is large and interferes with respiration so much as to necessitate beginning the operation under local anesthesia.

B. Tapping the cyst: Note how assistant maintains a continuous pressure on the abdominal walls as the fluid is being withdrawn. (From Crossen's *Operative Gynecology*, Mosby).



press upon the external abdominal walls from the instant the tumor is delivered (Fig. 76). This positive external pressure should be continued until a firm binder can be applied over a large pad of cotton, and thus from the completion of the operation the abdomen may be supported until the vascular system has become stabilized. Similarly, care must be exercised in performing an abdominal paracentesis that pressure-relief is not too sudden.<sup>97</sup>

#### The Scaphoid Abdomen

The scaphoid or navicular abdomen illustrates a passive collapse of the abdominal wall from inadequate opposition to the constant inward pressure of the atmosphere (approximately 15 lbs. to the square inch). Such abdominal retraction follows a severe reduction of the general intra-abdominal pressure, for example that following starvation, with the marked loss of weight in advanced carcinoma. The abdominal walls appear as though pushed inward by a huge fist. Muscular action could not explain this retraction for the scaphoid abdomen is usually found upon palpation to be soft, and were this shape simply due to a passive in-falling of the walls from the action of gravity as the patient assumes the dorsal decubitus, they would tend in a similar manner to fall flaccidly and passively outward when the erect posture was assumed. This, however, does not occur and the boat or bow-shape is maintained, in all positions, by the inward force of the atmosphere.

#### Contraction of the Walls

A simultaneous contraction of all of the muscles of the abdominal walls must cause a temporary increase in the general intra-abdominal pressure, quite regardless of what that pressure might have been before such contractions took place. As the pelvic floor is drawn upward, the anterior wall inward, and the diaphragm downward, aid is given to such acts as those of parturition and defecation. This action is enhanced by closure of the glottis. During the second stage of labor the abdominal pressure is a powerful auxiliary. "During an expulsion pain the woman closes the glottis and makes a powerful bearing down effort. She forces down the diaphragm and

#### Parturition

contracts the recti, the obliqui, and the muscles of the flanks. There is now a great increase of the intra-abdominal pressure which, obeying the law, is transmitted equally in all directions,

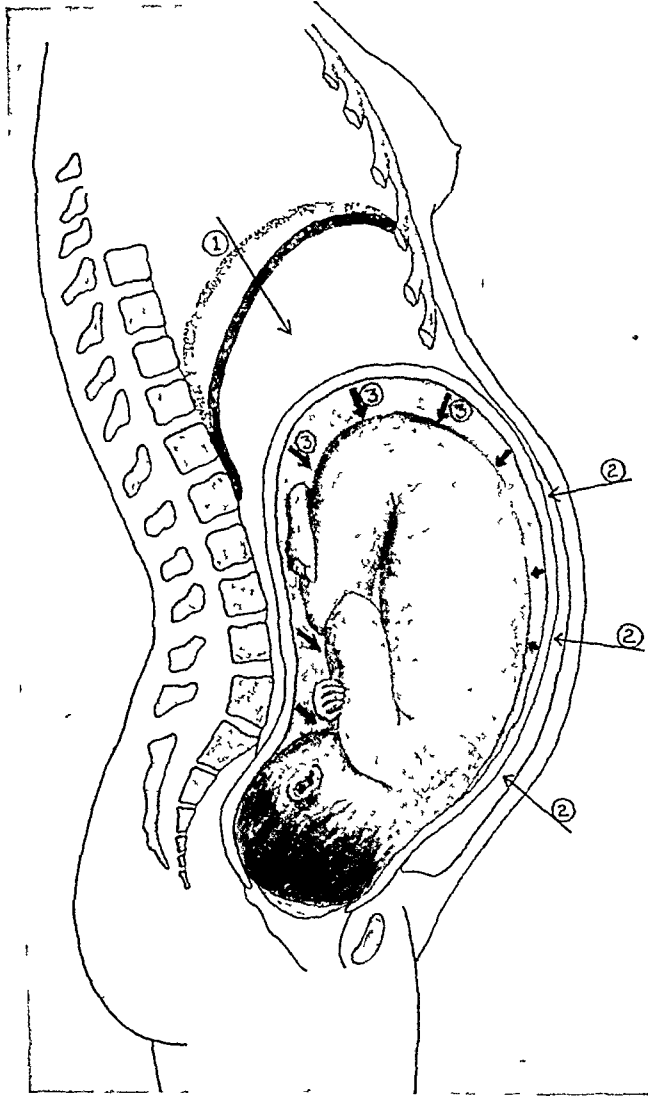


FIG. 77. The muscles of the abdominal walls acting as "auxiliaries" during the second stage of labor. "Intra-abdominal" pressure is added to the intrauterine pressure, aiding in the act of expelling the uterine contents. (Modified after DeLee.)

1. The downward movement of the diaphragm.
2. The inward movement of the abdominal walls.
3. Contraction of the uterine walls

the uterus receiving its share (Fig. 77). It is easy to see how the abdominal pressure is simply added to the intrauterine

pressure, resulting in increased general intrauterine pressure."<sup>98</sup>

McBurney and the  
Cough Impulse

Sudden voluntary increases in intra-abdominal pressure often prove of aid in diagnosis. The value of the cough impulse in the examination for inguinal hernia is well known. McBurney also made use of such a pressure increase in his test for acute appendicitis. In an original article, describing his point of maximal tenderness he wrote:<sup>99</sup> "I do not mean a tenderness elicited by pressing the entire hand into the right lower quadrant, but one which is definitely greatest at the point described, perhaps no greater an area than the tip of the index finger, where pain on pressure is most marked, particularly as the patient coughs." This voluntary increase in pressure was also used by Murphy in his method of examination for acute diseases of the gall bladder. The so-called "deep grip palpation test" which elicits the objective sign known as "Murphy's expiratory grunt" makes use of a steady pressure against the gall bladder, but relies upon the diaphragm to tell the story. The test is made as follows:<sup>100</sup> "standing directly behind the patient, providing the patient is well enough to assume the upright position, (while if not the examiner reaches over the recumbent patient from the head) the right hand of the examiner curls up under the right costal arch at the tip of the ninth cartilage; the patient is requested to take a deep breath and at the end of the expiration the examining finger seeks the gall bladder area and fixes it from beneath; the diaphragm, descending from above with the beginning inspiration, brings down the liver and gall bladder, and if the cholecystitis of cholelithic obstruction is present, the descent is checked suddenly with an accompanying groan from the patient. For the diaphragm, acting as a great piston of respiration, forces the distended, inflamed or congested gall bladder downward upon the firmly fixed hand, and the result is an abrupt cessation of the inspiratory act" (Fig. 78).

Murphy's Expira-  
tory Grunt

Aids to Palpation

Voluntary contraction of the diaphragm with deep inspiration or coughing, may also be used in detecting indefinite tumor

masses which tend to slip away from the examining fingers into the depths of the upper abdomen. Here, the palpating hands upon the anterior abdominal wall are held motionless while the



FIG. 78. "Deep-grip palpation." (From Keen's Surgery, Saunders.)

patient is asked to take a deep inspiration; thereupon the diaphragm, acting as though it were a huge internal hand, forces the mass downward against the examining fingers. This method of utilizing the diaphragmatic contraction may be combined with a use of gravity, carrying out the maneuver with the patient in the knee-elbow position.<sup>101</sup> Thus, as gravity carries the mass forward and the diaphragm forces it downward the examiner may often feel and definitely delimit a tumor, where before he had only a vague impression as to its existence. Still another use of voluntary muscular contraction for diagnosis may be demonstrated by the ease with which

weaknesses of the anterior abdominal wall may be seen and felt as the patient contracts the diaphragm, recti, and associated muscles in attempting to change from the supine to the sitting posture without the aid of his hands. The patient, it will be noted, closes the glottis and contracts the diaphragm during the effort to arise.

Dyspnea from  
Abdominal Dis-  
orders

When a pathological increase in the intra-abdominal pressure is associated with rigidity of the abdominal walls, any increase in abdominal capacity must be made at the expense of thoracic capacity, through an elevation of the diaphragm. Such a diaphragmatic elevation promptly gives rise to dyspnea or circulatory embarrassment. Because of the muscular rigidity present, inflammatory distentions give rise to pressure symptoms earlier than do those of purely toxic origin (where the walls may remain relaxed).

Certain mental defectives and neurotics may display in an interesting fashion the reciprocal relationship which exists between the diaphragm and the muscles of the anterior abdominal wall: By maintaining the diaphragm in a condition of spastic fixation, then simultaneously relaxing the anterior abdominal muscles, these patients are able to create the appearance of being tremendously distended (an hysterical tumor).<sup>102</sup> The administration of an anesthetic causes this "mass" to disappear immediately (phantom tumor). The swallowing of quantities of air (aerophagia) serves to enhance the tumefaction of the abdomen.

A Phantom Tumor

Still another example of an alteration in pressure due to changes in muscle tonicity is the effect upon the abdominal circumference of the ingestion of food. When food enters the enteric canal the intra-abdominal content is necessarily increased. To prevent this from causing an undue change in the actual intra-abdominal pressure, the abdominal walls become relaxed, through their reflex connections with the intestinal mucosa.<sup>103</sup> Such a reflex relaxation of the muscles may be experimentally demonstrated through the distention of balloons which have been placed within the enteric canal.

It is this reflex (entero-abdominal or alimentary reflex) at least in part, which causes the loosening of belts after meals. The change in the abdominal circumference is often out of all proportion to the amount of food ingested. An abnormally active reflex may give rise to "bloating" immediately after the taking of even a glass of water, a cracker or other substance of small bulk.

The Entero-  
Abdominal Reflex

It has been shown that the injection of a definite amount of air or fluid into the peritoneal cavity causes a rise in the systolic blood pressure, while the injection of a similar amount of the same substance into the enteric tract is not followed by a similar rise in pressure. An explanation of this observation, which would seem most puzzling since the same amount of the same substance placed within the same space (abdomen) acts so differently according to the site of the injection, is offered by this enteroabdominal reflex which accounts for the relaxation of the abdominal wall, thus preventing any marked increase in the intra-abdominal pressure, when the increased bulk occurs in the intestinal lumen (simulating normal eating).<sup>104</sup>

Rise in Blood  
Pressure from  
Increased Intra-  
abdominal Pres-  
sure

2. ABDOMINAL EFFECTS OF THE INTRAPLEURAL NEGATIVITY.<sup>1</sup> It has thus far been pointed out that the abdomen, a muscular sac exposed constantly to the action of the atmosphere, must tend to have a pressure which is approximately equal to that of the atmosphere itself; that when conditions arise which would otherwise increase the intra-abdominal pressure (paralytic ileus; excessive fat; ascites; tuberculous peritonitis) the muscle walls passively belly outward in such a fashion as to reduce the actual pressure within, and that when conditions arise which might otherwise cause a decrease in intra-abdominal pressure (diarrhea; dehydration; starvation; excessive loss of fat) the muscular walls are pushed inward (scaphoid abdomen) in such a fashion as again to diminish the actual change of pressure within the abdomen; that, however, by an active and simultaneous contraction of all the muscular walls the general intra-abdominal pressure may

suddenly be made to increase; but, upon the other hand, that there is no mechanism by which these muscular walls are capable of creating a generalized and sustained pressure which

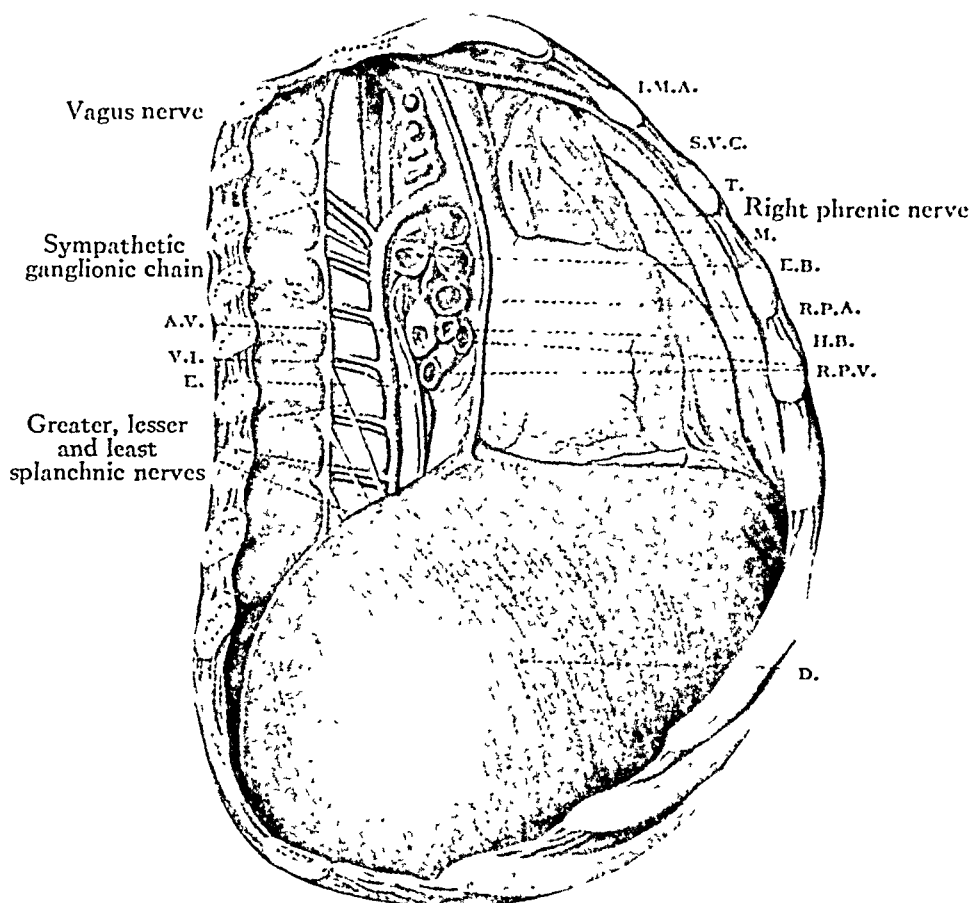


FIG. 79. Note the dome-shape of the diaphragm.

is below that of the atmosphere (a subatmospheric pressure). Notwithstanding these facts, there is one region within the abdomen in which a subatmospheric pressure is known to be normally present, i.e., the region immediately below the diaphragm. This negative pressure within the upper peritoneal cavity may be explained by the proximity of abdomen and thorax; it is a borrowed or reflected negativity; one which depends upon conditions present within the thorax, not upon the abdomen itself.

A Reflected Negativity

The abdomen is separated from the thorax only by a non-rigid partition. The dome shape of the diaphragm demonstrates the upward pull created by the subatmospheric pressure within the pleural cavities. The diaphragm does not gain its upward curvature through being suspended from above by thoracic structures. This must be apparent, since nothing pierces or is attached to the diaphragm at the points of greatest elevation (domes.) (Fig. 79.) Again, if the diaphragm were suspended from above, its normal excursions could not be made. It must be equally obvious that the diaphragm is not pushed upward from below, for when all abdominal organs have been removed (autopsy), the upward curvature remains. That the diaphragm is sucked upward by the subatmospheric pressure within the pleural sacs is demonstrated by the even higher levels to which the midriff ascends after a phrenic nerve has been paralyzed (eventration). The thoracic lifting effect may be still better shown as follows: suspend a cadaver in an upright position; observe the levels of the diaphragmatic domes and of the abdominal viscera; then open one of the pleural sacs, allowing an equalization of pressures; observe that the domes of the diaphragm, and also the abdominal organs, descend as air is admitted to the thorax.<sup>105</sup>

The Dome Shape  
of the Diaphragm

The same force which draws the diaphragm, upward, also exerts an upward pull upon the movable viscera of the abdomen. Thus, when a weakness occurs in the midriff, some movable organs of the upper abdomen actually enter the thorax. Thoracic suction is demonstrated by the fact, already referred to, that when the reduction of these herniated organs proves difficult or impossible from the abdominal side, the mere opening of the pleural cavity will often result in an easy or even spontaneous replacement of the viscera (the suction action overcome).

The Upward Pull  
of the Thorax

An important result of the negative pressure within the upper peritoneal cavity is that after perforation has occurred in some air-containing viscus, the free air which accumulates in the peritoneal cavity travels upward to the subdiaphrag-



**Obliterated Liver  
Dullness**

matic region. Even small amounts of gas tend to cause an early diminution or loss of liver dullness. The promptness and frequency with which shoulder pain is observed in the presence of free fluid or gas within the abdomen, demonstrates a subdiaphragmatic negativity. This early irritation of the central portion of the under surface of the diaphragm (with its attendant shoulder pain) often occurs even when the free substances originate at pelvic levels. Obliterated liver dullness from enteric perforations (Clark's sign) is best observed in the midaxilla.<sup>106\*</sup>

**Respiratory In-  
creases in the  
Abdominal Cir-  
cumference**

3. EFFECTS OF THORACIC MOVEMENTS. Contrary to what might be expected, the negativity within the upper peritoneal cavity is greater during inspiration than during expiration.<sup>105</sup> It might seem reasonable, upon superficial consideration, to assume that as the diaphragm moves downward (inspiration) the pressure within the abdomen must, of necessity, be increased. Yet manometer readings show that normally the negative pressure below the diaphragm is greatest during the inspiratory phase of the respiratory cycle, and that the greater the depth of thoracic breathing the greater the upper abdominal negativity during inspiration. This is true because the descent of the diaphragm is not the only, nor at times the most important, accompaniment of inspiration. It may be observed that in addition the diameter of the lower thorax (upper abdomen) undergoes an increase during the inspiratory act (Fig. 80). The fact that the abdomen extends upward so far within the thoracic cage (see midriff; roof of abdominal cavity) and that the upper abdomen is covered by ribs and thoracic walls, makes it inevitable that pressures within the upper abdomen should be markedly effected by movements of the thoracic cage. This increased abdominal circumference may more than equal the effect on pressure of the descent of the diaphragm. As might be expected, this effect of thoracic movements varies

\* Although this sign is present in but a minority of cases its value, when present is great. It has been said (Cope): "If in any acute abdominal case distinct resonance be obtained over the liver in the midaxillary line, about two or more inches above the costal border, one is certainly dealing with a perforation of a gastric or duodenal ulcer."<sup>107</sup>

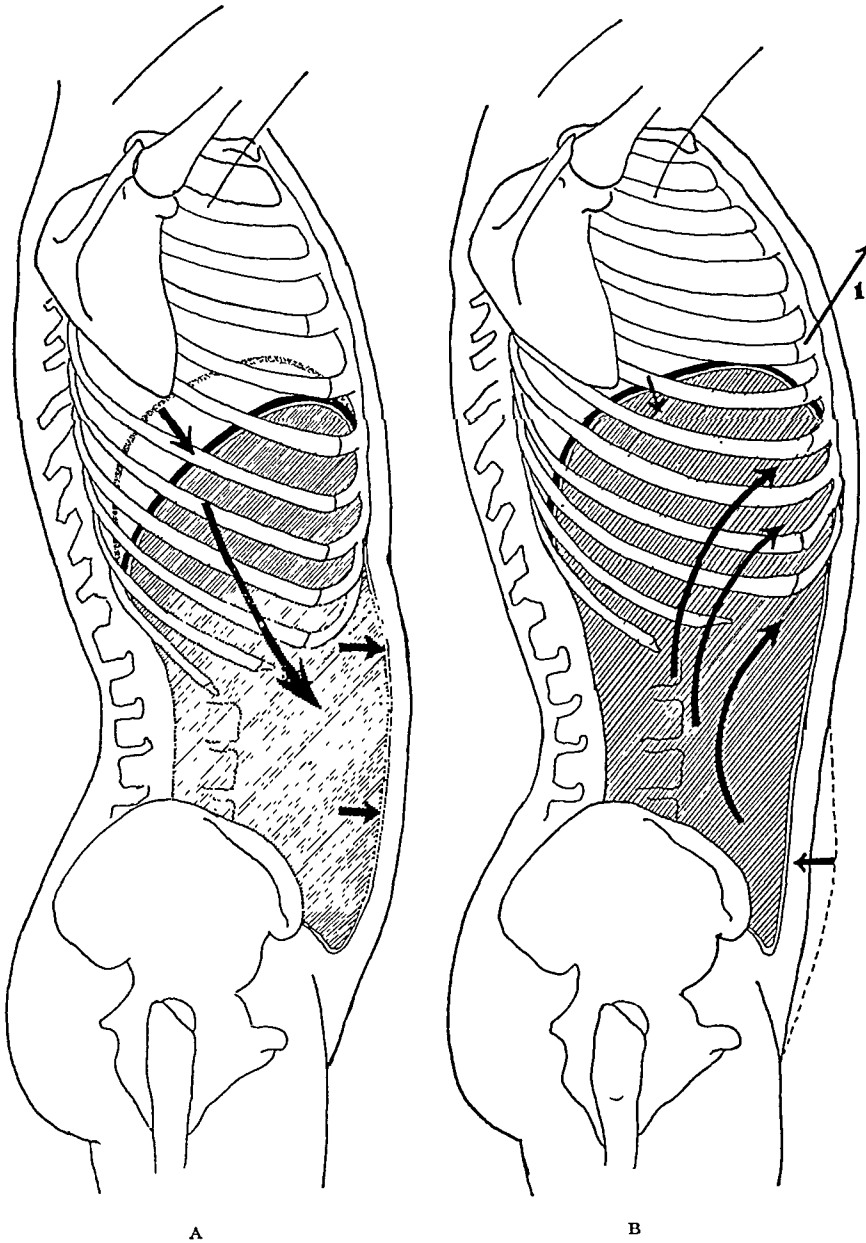


FIG. 80. Abdominal and thoracic types of breathing.

A. Abdominal inspiration: As the diaphragm descends there is a downward force which tends to cause bulging of the lower abdominal walls (general increase in intra-abdominal pressure).

B. Thoracic inspiration: As the anteroposterior and transverse diameters of the thorax are enlarged there is enlargement also of the upper abdomen resulting in an upward pull or "lifting" force within the abdominal cavity and the lower abdominal walls tend to move inward (general decrease in intra-abdominal pressure). Note: The slight movement of the diaphragm has not been shown.

### Pressure Variations with Various Types of Breathing

somewhat with the patient's type of breathing. With distinctly thoracic breathing (the costal muscles predominating) the general intra-abdominal pressure tends to fall during inspiration; with quiet normal breathing (combined abdominal and thoracic type) a fall in pressure within the upper abdomen synchronous with inspiration, is still observed; and it is only with the breathing of the abdominal type (thoracic cage remaining relatively quiescent) that the general intra-abdominal pressure shows any tendency to rise (increase) during the inspiratory act. The accuracy of these statements may roughly be tested by placing one hand over the lower portion of the abdominal wall and the other upon the upper portion while experiments are conducted with the various types of breathing, noting how the hands rise, sink or remain stationary during the inspiratory phase of the respiratory cycle.

### Opening the Peritoneal Cavity

The presence of an upper abdominal negativity and one which tends to increase during inspiration, explains why there is a minimum of danger of injury to abdominal structures when the peritoneal cavity is opened at its upper levels, particularly when this is done during the act of inspiration. The daring surgeon will, at times, cut through the abdominal wall without taking the precaution of picking up the peritoneal membrane before incising it. He knows from experience that with the first nick of the peritoneum, air usually rushes into the peritoneal cavity and "the organs fall away from the abdominal wall as the potential cavity becomes real." This is not, as is so often stated, an index that the peritoneal cavity possesses at all times and in all situations a generalized sub-atmospheric pressure, but is due to the fact that during inspiration (particularly with the forceful type observed under general narcosis) the thoracic cage is enlarged and with it the circumference of the upper portion of the abdomen, i. e., the abdominal walls are moving *away from* the intra-abdominal viscera (Fig. 81). This maneuver of incising the peritoneal cavity without picking up the peritoneal membrane has been repeatedly executed with impunity, but the wisdom of the procedure

is open to question, since upper abdominal adhesions or intra-visceral distentions may have altered the pressure conditions which normally made the procedure possible. In opening the

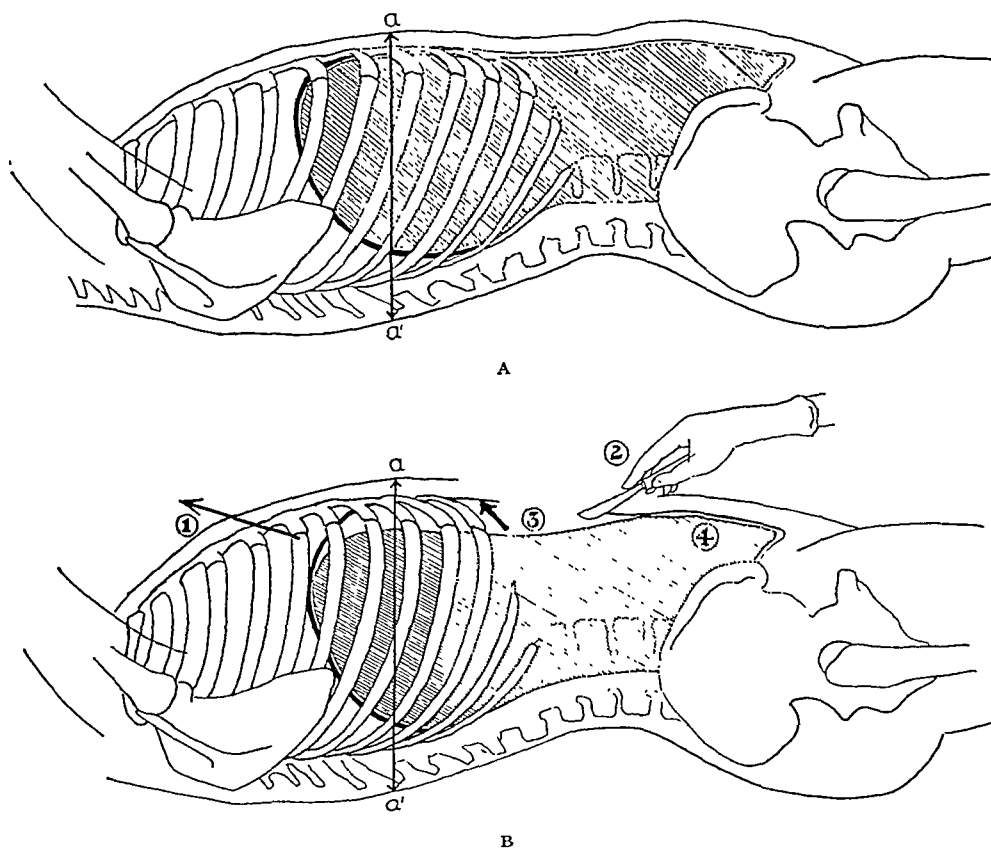


FIG. 81.

A. Abdomen at respiratory rest. Shaded area represents abdominal viscera.

B. Opening the upper abdomen during inspiratory phase of respiratory cycle. Note increase in the anteroposterior diameter ( $a - a'$ ) as the upper wall is pulled away from the abdominal viscera during forceful thoracic breathing. (1) Upward pull of thoracic cage. (2) Knife making incision. (3) Space between viscera and upper abdominal wall. (4) Little or no space between lower abdominal viscera and wall.

abdomen at lower levels, where the effects of the thoracic respiratory expansions are less noticeable and there is no respiratory increase in the abdominal circumference, one should always pick up the peritoneum and lift it away from the organs below before it is incised.<sup>109</sup>

4. THE EFFECT OF INTRALUMINARY PRESSURES. Each of the hollow viscera (stomach, intestine, gall bladder, urinary

bladder) has an intraluminary pressure of its own. These internal pressures are continually changing and they all have an influence upon the general intra-abdominal pressure. Any pressure change, whether an increase or decrease, within one organ must be compensated for by changes in other structures or by a change in the size of the cavity as a whole. The detailed study of these individual intrinsic pressures will be found elsewhere (see movements of the intestinal tract, basis of abdominal symptoms); but a few clinical points will be presented to illustrate the relationship existing between intravisceral, intraperitoneal and general intra-abdominal pressures.

Normal Disposal  
of Intestinal  
Gases

The most common cause of a general increase in intra-abdominal pressure from visceral distention is that which occurs with accumulations of gas or fluid within the gastrointestinal tract (tympanities; tumid abdomen; paralytic ileus). It is obvious that with a complete mechanical obstruction of the bowel there must result an increasing accumulation of contents (food, water, products of glandular secretion) cephalad to the point of obstruction. It is, however, not quite so obvious how an even more rapid collection of gas or fluid may occur within a loop of bowel which is isolated, i.e., one which has been cut off from the remainder of the enteric tract and is receiving no increase in substance from above, (example, strangulation ileus). This phenomenon, and others which must be dealt with in the diagnosis and treatment of the many varieties of intestinal obstruction, are due to the fact that the integrity of the circulation has more bearing upon the rate and severity of distention of bowel than has the integrity of the intestinal lumen.<sup>109</sup> Only a small proportion of intestinal gases are eliminated through the anus while the great bulk is absorbed into the circulation, there to be altered chemically or eliminated through other channels. The elimination of intestinal gases through the lungs alone is estimated to exceed that occurring by way of the anus by a proportion of ten to one. This explains the fulminating character of the

distention observed with mesenteric thrombosis. Indeed it is a general rule that the more sudden the occurrence of meteorisms the more likely is the cause to be an interference with blood supply rather than one of mechanical interference with the enteral lumen alone.<sup>110</sup> The disappointing results which often follow the relief of a mechanical obstruction are probably due, in many cases, to vascular alterations which have concomitantly occurred. Thus it is usually necessary to empty the bowel at the time of operation for intestinal obstruction as well as to resect gangrenous gut or to remove the actual obstruction at the lumen. The statement has been made that no operation for intestinal obstruction may be considered complete if the abdomen remains distended at the time of abdominal closure.

Mesenteric  
Thrombosis vs.  
Mechanical Ileus

Much harm may result from suddenly decompressing an abdomen distended by paralyzed bowel, *in the presence of an acute peritonitis*. This is particularly true when the patient has reached a critical or moribund condition. To perform an ileostomy and allow the trapped gas and fluids to gush forth, as is sometimes done, until the ultimately desirable relaxation of the walls has occurred, must exert a great strain upon the circulation and have an effect upon protective adhesions somewhat similar to that of running the hands through the abdomen, pulling one loop of bowel from another until all pockets of pus have been turned into a single pool. Patients so handled not infrequently die a few hours after operation with evidences of circulatory failure and with a steadily rising temperature. After the ileostomy has been performed, the catheter or tube leading from the bowel may, to advantage, be intermittently clamped and opened, and the pressure thus more carefully and gradually reduced.

Ileostomy with  
Peritonitis

It has been suggested that splanchnic nerve block or spinal anesthesia be utilized in selected cases as a therapeutic measure for securing relief from intestinal stasis.<sup>111</sup> The process is described as an activation of the vagus, or motor mechanism of the bowel, secured through an induced paralysis

Splanchnic Nerve  
Block for Paralytic  
Ileus

of the splanchnic nerves, which have been exerting an undue inhibitory influence upon enteral motility. (Fig. 82.) Care must be used in applying this suggestion since the method

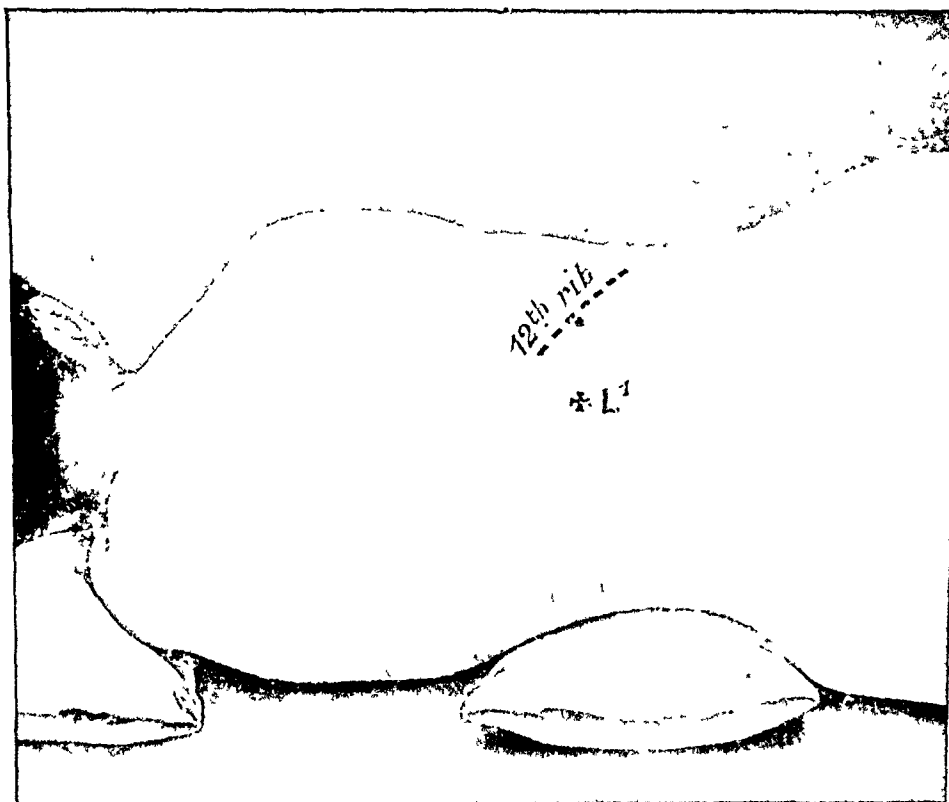


FIG. 82.

A. Splanchnic analgesia. Position of patient. The point just under the twelfth rib marks the site of puncture, and the cross, vertically under, is the spinous process of the first lumbar vertebra. The distance between the two is 4 fingerbreadths or 7 cm. (From Labat's Regional Anesthesia, Saunders.)

is theoretically not suitable to cases with mechanical or spastic obstruction, but is of use only in the paralytic or adynamic cases.

Considerable intravisceral pressure may safely be endured within an organ which has walls of normal strength. But even a much diminished pressure may later cause a rupture of this organ when its walls have become necrotic or have been injured. Thus a distended gall bladder, undergoing a reduction

The Rupture of a  
Viscus

in size under expectant treatment while the patient is apparently progressing satisfactorily toward a cure, may suddenly perforate and post-mortem examination reveal that the wall

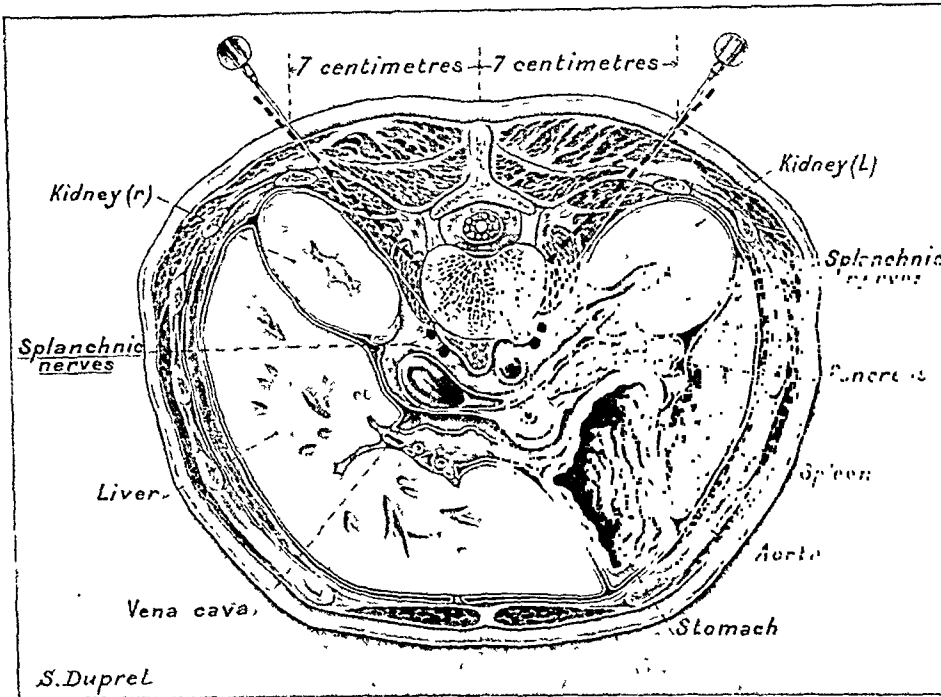


FIG. 82.

B. Cross-section through the first lumbar vertebra, showing the method of inducing splanchnic analgesia. The needle has been inserted on the lower border of the twelfth rib, 7 cm. distant from the midline of the back. The dotted line marks the direction of the needle introduced toward the spine at an angle of 45 degrees with the median plane of the body. Note its point of contact with the vertebra; the needle is here in its last and good direction: tangent to the body of the vertebra. (From Labat's Regional Anesthesia, Saunders.)

had gradually become weakened from an impacted stone or from an area of gangrene caused by infection and thrombosis. Again, it is well known that the site of an intestinal anastomosis is stronger shortly after operation than it is from three to five days later when sutures have softened and liquefaction necrosis has occurred in traumatized areas. At the time of such secondary weakness the injured area should be carefully protected from excessively high intraluminary pressures. It is preferable to gently introduce a stomach tube promptly



upon the onset of vomiting in the early postoperative period after gastroenterostomy than to allow an overfilling of weakened walls at a later period.<sup>112</sup> Lavage may be intermittent or continuous (see Kanavel, Bossler and Levin tubes).

Exploring the  
Abdomen

At the time of operation the abdomen is often found to be filled with distended intestinal loops making it difficult to conduct a proper exploration. There seems scarcely room to crowd the examining hand into the overfilled space. Lateral retraction of the wound margins only serves to favor evisceration. Strong *upward* retraction, however, draws the anterior abdominal wall away from the distended viscera and provides ample space through which to slide the examining hand to all parts of the peritoneal cavity without causing displacement of organs or needless trauma. Such traction away from the viscera also proves of aid when the peritoneal margins are being sought and when they must be grasped by forceps without causing injury to other structures.

Gastromesenteric  
Ileus

An important example of an increased intraluminary pressure is the condition known as gastromesenteric (or duodenomesenteric) ileus.<sup>113,114</sup> Here the stomach and proximal duodenum undergo rapid and tremendous dilatation; at times the greater curvature of the stomach may within a few hours reach to the level of the pelvis, the gastric distention causing considerable displacement of movable structures within the addomen and thorax. The outstanding triad of symptoms of gastromesenteric ileus is; pain (which may become excruciating as the distention increases); repeated, effortless vomiting; and cyanosis. These are immediately and dramatically relieved by the passage of a stomach tube. They may, however, rapidly recur as the intravisceral tension again rises. Repeated lavage yields repeated relief. The condition is supposedly caused by a constriction of the terminal duodenum as it is crossed by the root of the mesentery of the jejuno-ileum, and particularly by compression of the duodenum against the vertebrae by the superior mesenteric artery. (Fig. 83.) Gastromesenteric ileus is a relatively frequent

complication of intra-peritoneal operations, particularly those performed within the pelvis. The condition is predisposed to by anything which causes downward traction upon the

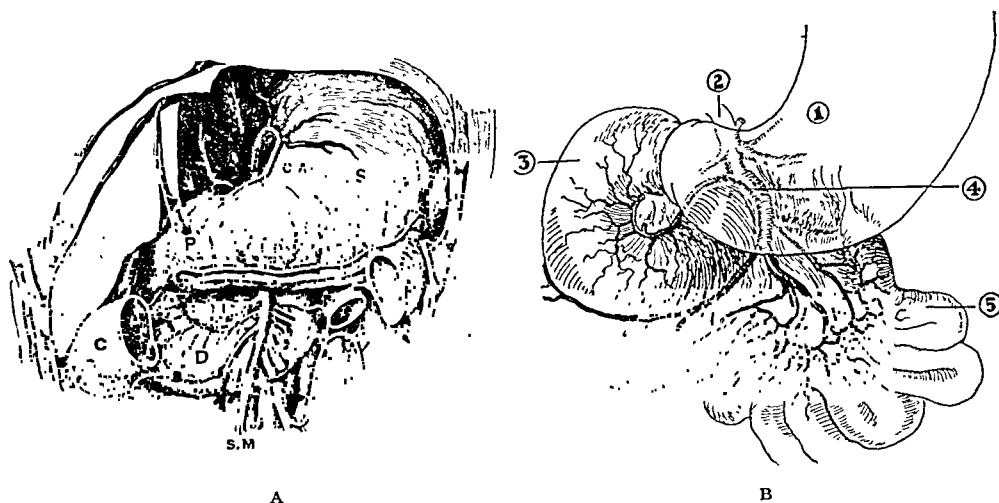


FIG. 83.

A. Position and relations of the stomach and duodenum, showing also their arterial supply. (From Testut.)

S, Stomach. P, Pylorus. D, Third part of duodenum. C, Hepatic flexure of colon (note transverse colon is cut away). C.A., Coronary artery. G.E.D., Right gastroepiploic artery running in the great omentum. S.M., Superior mesenteric artery, with its inferior pancreaticoduodenal branch (P.D.I.).

B. Duodenomesenteric or gastromesenteric ileus. Showing the constriction of the last portion of the duodenum by the superior mesenteric artery.

(1) Dilated stomach. (2) Abdominal aorta. (3) Dilated duodenum. (4) Point of obstruction by superior mesenteric artery. (5) Collapsed loops of proximal jejunum distal to obstruction.

small intestines and puts tension upon the mesentery. A change in posture of the post-operative suffered, placing him face downward, tends to relieve the duodenal compression and is the surest measure for producing permanent relief. The condition, often unrecognized, is an urgent complication having a high mortality but one which, if treated early, may quite certainly and promptly be cured through a combination of postural treatment and gastric lavage.

## Eponym

## FRIEDRICH TRENDELENBURG

- Eponym:** Trendelenburg position.
- Nativity:** Berlin.
- Birth-Death:** May 24, 1844. December 15, 1924.
- Education:** Earliest education was received at home (was taught English by his mother, Latin and arithmetic by his father, grammar by his aunt).  
Subsequently attended a boys' school in Berlin.  
In 1862 was give the option of attending a boarding school in Berlin or going to Scotland with his family for the year; chose the latter.  
1863. Went from Edinburgh to Glasgow, where he studied anatomy, embryology and physics; tutored in family with whom he lived.  
1863. Matriculated in University of Berlin.  
1864. Took preliminary medical examinations. Studied surgery and internal medicine in clinics of von Langenbeck, Traube and Jungen.  
1865. Travel study in Jena, Halle, Heidelberg and throughout central Germany.  
1866. Received degree in medicine. Made military surgeon in hospital in Gorlitz.  
1867. Took state examinations and wrote his thesis on Ancient Indian Surgery (De veterin Indorum chirurgia). Military surgeon at Kiel.
- Connections:** 1868-74. Assistant to Langenbeck.  
1872. Founded German Society of Surgeons.  
1874-75. Director of surgical ward, Friedrichschain Hospital, Berlin.  
1875-82. Ordinarius of surgery, University of Rostock.  
1882-95. Ordinarius of surgery, University of Bonn.  
1895-1911. Ordinarius of surgery, University of Leipzig.  
1898. Chairman, German Society of Surgeons.  
1923. Historian, German Society of Surgeons.
- Writings:** Trendelenburg did important work with regard to plastic surgery, congenital hip joint disease, physiology of varicose veins, pulmonary embolism, gynecological and abdominal surgery.  
Among his papers were the following:  
Ueber Heitung der Harnblasen Ectopic durch directe Vereinegung der Spaltrander (1886).  
Ueber Isobering in Chirurgischen Kliniken (1892).  
Ueber Operationen zur Heilung der Angeborenen Harnblasen und Harnrohrenspalte (1892).  
Zur Operation der Blasenscheiden Fisteln von der Blase Ous (1892).  
Chirurgische Krankheiten der Gesichtsnerven (1908).
- Source of Eponym:** Ueber Blasenscheidenfisteloperationen und ueber Beckenhochlagerung bei Operationen in der Bauchhohle. (*Volkmanns Samml. klini. Vortrage*, Leipzig, 1890).
- Discussion of Eponym:** The Trendelenburg position was first recorded by Willy Meyer in 1885. Meyer was then a student of Trendelenburg and published the description with the permission of his "venerable chief." (See photostat, Fig. 84.)  
Trendelenburg himself first wrote concerning "high pelvic elevation" in 1890 (see photostat, Fig. 84).  
The position was an attempt to introduce air into the open bladder following the "principle of Sims' posture (1845) where the vulva is the most elevated point of the body and the opened vagina admits the air because of negative intrapelvic pressure and thus becomes distended."

# Sammlung Klinischer Vorträge

in Verbindung mit deutschen Klinikern

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Richard von Volkmann.

No. 355.

(Staufendunstiges Heft der zweiten Serie)

Ober Blasenscheidenfisteloperationen und über Becken-  
hochlagerung bei Operationen in der Bauchhöhle

von

Friedrich Trendelenburg.

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355.

(Chirurgie No. 109)

Über Blasenscheidenfisteloperationen und über Becken-  
hochlagerung bei Operationen in der Bauchhöhle.

Von

Friedrich Trendelenburg,

in Bonn

Mit einer Lichtdrucktafel.

Seit ihrer Begründung durch Naegele, Dieffenbach und Lo-  
bert de Lamballe ist die Operation der Blasenscheidenfistel, besonders  
durch das operative Talent und die unermüdliche Ausdauer von Gustav  
Simon, zu einem so hohen Grad von Vollkommenheit gebracht worden  
dass dieses Kapitel der gynäkologischen Chirurgie auf den ersten Blick  
fast vollständig abgeschlossen zu sein scheint. Neuere Vorschläge be-  
ziehen sich auf Modifikationen der Instrumente, der Lagerung und des  
Nahtmaterials, der Vorbereitung zur Operation und der Nachbehandlung,  
das Princip der Operation bleibt immer dasselbe.

Meine ersten, allerdings erfolglosen Versuche in dieser Richtung  
(1881 u. 1884)<sup>1)</sup> sind ziemlich unbeachtet geblieben. Nur König hat  
sie wiederholt. Es hängt dies damit zusammen, dass auch die »Becken-  
hochlagerung«, welche allein das Innere der Blase so aufzuschnellen  
vermag, dass man feinere Operationen in der Blase vornehmen kann,  
längere Zeit nicht die Beachtung gefunden hat, die sie meiner Überseu-  
gung nach verdient.

Ich möchte daher das Wesen und die Vortheile dieses Verfahrens  
in kurzen Worten nochmals hervorheben.

Lagert man den Körper eines Kranken auf dem Operationstisch so,  
dass die Symphysis pubis der höchste Punkt des Rumpfes ist und die  
Axe des Rumpfes mit der Horizontalen einen Winkel von wenigstens  
45° bildet, so sinken sämtliche Eingeweide, vor Allem Leber, Milz und  
Mesenterium, durch ihre Schwere in die Höhlung des Zwerchfells hinunter.  
Der Darm folgt und fällt aus dem kleinen Becken heraus, so weit der  
Luftdruck dieses zulässt. Bei mageren Individuen und erschlafenen Rektum  
in tiefer Narkose wird die vordere Bauchwand in der Regio hypogastrica  
von der Beckenhöhle her förmlich angesaugt, so dass sich in dieser Ge-  
gend eine tiefe Grube bildet.

Macht man nun in der Regio hypogastrica zum Zweck des Stein-  
schnitts einen Längs- oder Querschnitt und spaltet die Rektum sowie die  
hinter ihnen liegende Fascie, so tritt sofort Luft in den prävesicalen  
Raum ein, oft mit hörbarem Geräusch, die Peritonealfalte fällt herunter,  
und aus dem prävesicalen Spaltraum wird ein weitklaffender Hohlraum,  
in dem das Licht frei hineinscheint und in dem das Auge die vordere  
Wand der Blase und die Umschlagfalte des Peritoneum sehen kann.

1) Willy Meyer, Über die Nachbehandlung des hohen Steinschnitts sowie über  
Verwendbarkeit desselben zur Operation von Blasenscheidenfisteln. Arch. f. klin. Chir.  
1885 Bd. XXXI p. 521.

2) Verhandlungen der Deutschen Gesellschaft f. Chirurgie XVII 1889 p. 100.

FIG. 84A.

[221]

A. J. S., n. s. Vol. VIII, No. 5, p. 1153

## Friedrich Trendelenburg,

Ebenso überraschend ist der Nutzen der Beckenhochlagerung bei intraperitonealen Operationen in der Beckenhöhle und den unteren Abschnitten des Bauches.

Es handelt sich z. B. um eine Darmresektion, durch welche ein widernatürlicher After am Schenkelring (nach Brucheneinklemmung) beseitigt werden soll. Die Patientin wird in Beckenhochlage gebracht dicht oberhalb der Fistel (die Patientin stehend gedacht wird ein etwa 10 cm langer bogenförmiger Schnitt parallel dem Poupart'schen Bande durch die Bauchdecken gemacht, das Peritoneum wird incidiert, Luft dringt in die Peritonealhöhle ein, sämtliche Darmschlingen rutschen nach dem Zwerchfell zu hinab. Die Wundränder werden mit Haken auseinander gezogen, und wir sehen nun in das leer gewordene kleine Becken hinein, wir übersehen die ganze Fossa iliaca, und der einzige Darmteil, der sich präsentiert, ist die an den Schenkelring angelobete Schlinge. Wir können das Verhalten ihrer beiden Schenkel zu einander mit dem Auge kontrollieren, können sie bequem mit dem Finger anhaften, hervorziehen, durchschneiden und vernähen, kein Inhalt fließt aus, da, was von flüssigem Inhalt etwa noch da war, nach dem Zwerchfell zu abgeflossen ist. Wir arbeiten dabei im vollen Licht des gegenüberliegenden Fensters, wie der Maler an seiner Staffelei, ohne genötigt zu sein, uns zu bücken und, falls die Narkose ruhig ist, ohne durch heraustretende Darmschlingen belästigt zu werden.

In gleicher Weise machen sich die Vortheile der Beckenhochlagerung bei allen gynäkologischen Operationen in der Beckenhöhle geltend und ich glaube, wer einmal einen Uterus mit Myomen oder eine vergrößerte Ovarialzyste in dieser Weise exstirpiert hat, wird sich nicht leicht dazu entschließen zu dem alten Verfahren zurückzukehren. Soweit ihre Verbindungen im kleinen Becken es gestatten, fällt die Geschwulst aus der Beckenhöhle heraus dem Operateur entgegen, alle zu trennenden Verbindungen spannen sich an, das Blut fließt von dem Operationsfeld ab, um die Dürre braucht man sich, so lange kein Blutbrechen erfolgt, garnicht zu kümmern, als bleiben bescheiden in der Magengrube liegen, vor Allem man sieht was man macht.

Dass der Druck in dem unteren Abschnitt der Bauchhöhle bei der Hochlagerung des Beckens ein negativer wird, lässt sich an einem Manometer leicht demonstrieren. Man braucht dasselbe nur durch einen Gummischlauch mit einem Katheter in Verbindung zu setzen, welcher in die Blase eingeführt ist. Bei horizontaler Lage des Körpers ergab sich bei einigen Versuchen ein Druck von  $+1$  cm, bei Beckenhochlagerung ein Druck von  $-6$  bis  $8$  bis  $-11$  cm Wasser.

In historischer Beziehung ist zu bemerken, dass die Beckenhochlagerung schon von den alten Chirurgen bei der taxis eingeklemmter Brüche angewandt wurde, die eingeklemmte Darmschlinge sollte durch die Schwere des Mesenterium aus der Bruchpforte herausgezogen werden, durch kräftiges Schütteln des Körpers suchte man das Herausgleiten zu befördern. So empfiehlt Fabricius ab Aquapendente, den Kranken an Händen und Füßen aufzuhängen, den Kopf hintenüber und das Becken höher als den Thorax, und den Schwelenden tüchtig zu schütteln. Corvillard liess den Kranken an den Beinen aufliegen. Nach Sharp soll ein Gehilfe den Kranken auf den Rücken nehmen, die Unterschenkel über die Schultern ziehen, so dass die Kniekehlen des Kranken gerade auf den Schultern des Trägers ruhen. Auch dabei wurde geschüttelt. Ähnlich verfuhr Ribes', Freund' lagerte einen Patienten bei der Exstirpation des catenariformen Uterus (1818) auf einem Tische.

Ich selbst habe die Beckenhochlagerung zunächst nur bei Operationen an der Blase zu dem Zweck angewandt, um nach der Einföhrung der Blase durch hohen Steinschnitt das Innere der Blase dem Tageslicht und dem Auge zugänglich zu machen (1850). Mit der Freund'schen Mittheilung hatte die Sache nichts zu thun, es schwebte mir vielmehr das Princip der Seitenauflage von Sims (1853) vor, bei der bekanntlich die Vula den höchsten Punkt des Klumpes bildet und die geöffnete Vagina in Folge des negativen Druckes im Becken Luft aspirirt und dadurch zum Hülfsen gebracht wird. In gleicher Weise wollte ich die geöffnete Blase auch mit Luft füllen lassen. Erst später wurden mir die grossen Vortheile der Lagerung für die Operation des hohen Steinschnittes selbst klar, und dieselbe auch bei Laparotomien anzuwenden war ein weiterer sehr natürlicher Schritt. Seit 1881 operire ich bei jedem hohen Steinschnitt, seit Winter 1887 bei allen Laparotomien, wo es sich um Operationen in der Beckenhöhle handelt, von Anfang an nur in Beckenhochlagerung, und es ist kein Semester vergangen, wo ich meinen Zuhörern nicht die eine oder andere Operation der Art demonstrieren hätte.

Über die Technik der Beckenhochlagerung ist nicht viel zu sagen. In den ersten Jahren liess ich einen am Kopfende des Operationstisches stehenden Wärter die Knie des Patienten rücklings auf die Schultern nehmen, wie es die Alten mit ihren Bruchkranken machten, seit längerer Zeit benutze ich einen von Fachbaum konstruirten besonderen Apparat, der an dem Kopfende des Operationstisches angebracht wird. Fachbaum hatte ihn auf der Kölner Naturforscherversammlung (1885) ausgestellt. — Man beginnt die Operation erst wenn die Narkose vollständig geworden ist und alles Pressen und forcirte Athmen aufgehört hat. Auch während der Operation ist darauf zu achten, dass die Narkose eine vollständige bleibt durch die tiefe Lage des Kopfes wird sie gewöhnlich in keiner Weise ungünstig beeinflusst. Je magerer das Individuum ist und je leerer der Darm, um so mehr kommen die Vortheile der Lagerung zur Geltung.

FIG. 84B.

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FÜR  
KLINISCHE CHIRURGIE  
HERAUSGEGEBEN  
VON  
DR. B. VON LANGENBECK,  
Wirklichem Geh. Rath und Prof. der Chirurgie.  
REDIGIRT  
von  
Dr. BILLROTH,  
Prof. der Chirurgie in Wien.  
und  
Dr. GUBLT,  
Prof. der Chirurgie in Straßburg.

REINHARDTSCHE VERLAGS-ANSTALT  
BERLIN, 1885  
VERLAG VON AUGUST HIRSCHWALD.  
P. W. Unter den Linden No. 52.

XXIX.  
Ueber die Nachbehandlung des hohen Steinschnittes sowie über Verwendbarkeit desselben zur Operation von Blasenscheidenfisteln.

Von  
Dr. Willy Meyer,  
Assistenten an der chirurg. Universitätsklinik zu Bonn.  
(Mit einem Holzschnitt)

Bei der grösseren Beachtung, welche der hohe Steinschnitt in den letzten Jahren wieder gefunden ist die Frage der Nachbehandlung vor allen eine häufig ventilirte. Primäre antiseptische Blasen- naht — mit oder ohne Einlegen eines Verweilkatheters — und Oclusivverband, und Drainage der Blase durch die Bauchwunde mit offener Wundbehandlung oder folgendem Lister'schen Ver- bände stehen sich noch gegenüber. Auch Offenlassen der Blasen- wunde ohne jede Drainage ist versucht worden

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Dr. Willy Meyer,

stützen, die Patienten mit Blasen-tumor möglichst früh der Opera- tion zu unterziehen, noch ehe die Kranken durch die Blutungen zu sehr geschwächt sind und ehe sich Nierenerkrankungen einge- stellt haben

Es sei hier noch der bereits kurz berührten Lagerung des Kranken gedacht, die Herr Prof. Trendelenburg seit längerer Zeit bei Operationen im Inneren der Blase in Anwendung zieht. — Wie die beige-fügte Skizze des Herrn Dr. Stricker (s. die Figur) trefflich veranschaulicht, wird der Patient (nach eröffneter Blase) auf dem Operationstische vollkommen umgedreht. Der Kopf liegt tief unten, Hintertheil und Becken hoch erhoben auf dem Rande des Kopfstückes. Ein Wärter, welcher dem Operationstische den



Ueber die Nachbehandlung des hohen Steinschnittes u. s. w. 515

Rücken zuwendet, hält die gespreizten und in den Knien gebeugten Beine des Patienten auf seinen Schultern fest und sorgt so für unverrücktes Einhalten der Lage. Wie leicht begreiflich sinken jetzt die Eingeweide, der Schwere folgend, nach dem Zwerchfell zu herunter, die eröffnete Blase klappt — nach Art der Vagina bei der Sims'schen Seitenlage — und gestattet nicht nur vollkommen freien Einblick in das Innere, sondern auch, nach Auseinanderhalten der Bauch- und Blasenwandränder vermittelt breiter, stumpfer Wundhaken, am Besten wohl der grossen v. Langenbeck'schen Resectionshaken, oder nach Anziehen einer jedersits durch den Wundrand geführten Fadenschlinge, bequemste Einführung der zur Exstirpation und sonstigen Manipulationen notwendigen Instrumente. Besonders zugänglich für Instrumente und Blick wird auf diese Weise auch die Gegend des Trigonum laeutaudii, der häufigsten Insertionsstelle der Blasen-tumoren. Steht der Operationstisch, wie gewöhnlich, mit dem Fussende dem Fenster zugewandt, so fällt das Licht eben direct vom Fenster her in den unteren hinteren Abschnitt der Blase hinein und erhellt so nicht nur das Orific. int. ureth., sondern auch sehr ausgiebig die Gegend der Ureteren- mündung. Man kann so Beobachtungen machen, die bei der ge- wöhnlichen Rückenlage nicht möglich sind.

Fig. 84c.

[223]

Trendelenburg was also influenced in his belief that the movable viscera might be carried out of the pelvis by the aid of gravity by his knowledge of the method employed by Fabricius of Aquapendente and others in the treatment of incarcerated inguinal and femoral hernias (hanging patients by feet or by hands and feet while the suspended body was shaken or jostled).

The position as first employed was maintained by an assistant who stood with his back to the patient, the patient's legs being flexed over his shoulders (see Fig. 84). Special supports, attached to the operating table, were later perfected and it then became unnecessary to hold the patient in the desired posture manually.

It has been written that "to have thought of high pelvic elevation (when surgical gynecology was a science still in its infancy) so that all organs drop out of the operative field, was as much of a feat as when Columbus made the egg stand on end."

#### Points of Interest:

Trendelenburg's family dates back to 1459. His great-great-grandfather was a physician, his grandfather a lawyer, his father a professor of philosophy at the University of Berlin. Trendelenburg was the only living son in a family of eight children (six sisters and one brother who died in early youth).

He married in 1874 (Charlotte Fabricus) and was the father of six children. His family life was most happy and in later years he traveled extensively with his wife and children.

Trendelenburg's autobiography is modestly written and is a thoroughly charming document.

#### Special

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#### TRANSLATION OF ARTICLE BY TRENDELENBURG

#### OPERATIONS FOR VESICOVAGINAL FISTULA AND HIGH PELVIC ELEVATION IN ABDOMINAL SURGERY

Since its establishment by Naegele, Dieffenbach and Jobert de Lambelle the operation for vesicovaginal fistula, particularly through the surgical genius and indefatigable energy of Gustav Simon, has been raised to such a high degree of perfection that one might well assume offhand the last word had been spoken on this subject in gynecological surgery. All later suggestions involved modification of the instruments and sutures used, posture, preoperative and postoperative treatments. Yet the fundamentals of the operation remained essentially constant. . . . .

My first and unsuccessful attempts with this method in 1881 and 1884 (*cf.* Meyer, W., *Arch. f. klin. Chir.*, 31: 521, 1885) remained practically unnoticed. König (*Verhdl. d. Deut. Ges. f. Chir.*, 17: 100, 1888) was the only one who tried it. One reason for this apparent neglect was that for a long time far less attention than it deserves was paid to "high pelvic elevation," which is the only method to make the interior of the bladder sufficiently accessible to permit undertaking more delicate operations inside the bladder.

Therefore I wish briefly to emphasize the character and advantages of this method.

If the patient is placed on the operating table so that the pubic symphysis is the highest point and the axis of the body forms with the horizontal an angle of at least 40 degrees, then all viscera, particularly liver, spleen and mesentery, drop by gravitation into the dome of the diaphragm. The intestines leave the small pelvis corresponding to the degree of the air pressure. In thin subjects under deep narcosis when the (abdomi-

nal) recti are slackened, the anterior abdominal wall in the hypogastric region becomes practically sucked into the pelvic cavity and forms a deep pit.

If at cystotomy the hypogastric region be longitudinally or transversely incised, separating the recti and posterior fascia, the air immediately and often audibly fills this prevesical space, the peritoneal fold drops down, the prevesical cleft opens into a wide cavity freely admitting the light and plainly exposing to view the anterior bladder wall and parietal-peritoneal fold. . . .

The advantage of high pelvic elevation is equally surprising in intraperitoneal operations of the pelvic and lower abdomen.

Take, for instance, a case of intestinal resection requiring the removal of an artificial anus at the femoral ring (after incarcerated hernia). The woman is placed in high pelvic elevation. Close above the fistula (patient imagined standing) a 10 cm. curved skin incision is made parallel to Poupart's ligament; the peritoneum is incised; the peritoneal cavity is filled with air; all intestinal loops slide down to the diaphragm. The edges of the wound are retracted with hooks. In the empty small pelvis before us we can survey the entire iliac fossa; the only presenting intestinal portion is the loop adhering to the femoral ring. We can optically control the behavior of its two legs; we can draw it forward with the finger, cut and suture it. It will not leak for whatever fluid it contained has been drained in the direction of the diaphragm. The surgeon operates in the full light of the window opposite, as the painter at the easel; he does not have to stoop, nor is he annoyed by protruding intestinal loops provided the patient is quiet during narcosis.

The advantages of high pelvic elevation become equally apparent in all gynecological operations of the pelvis. I believe no surgeon will revert to the former method who once tries hysterectomy for myoma, or extirpation of an adherent ovarian cyst in high pelvic elevation. The tumor from the pelvic cavity fairly drops into the surgeon's hands so far as adhesions in the small pelvis will let it; adhesions for separation are taut; the blood runs off the operating field; if the patient does not vomit then the intestines require no attention for they modestly retire to the pit of the stomach. Above all, the surgeon sees what he does! . . .

Manometric demonstrations readily show that in high pelvic elevation the pressure in the lower abdomen becomes negative. The manometer is connected by a rubber tube with the catheter introduced into the bladder. Tests made at horizontal posture showed plus 1 cm. pressure, at high pelvic elevation minus 6 to 8 to minus 11 cm. water pressure.

With respect to the history of high pelvic elevation we find that the method was already used by early surgeons in taxis of incarcerated hernia. The idea was to withdraw the incarcerated intestinal loop from the hernial aperture by the weight of the mesentery; by forcibly shaking the patient at the same time it was hoped to accelerate the procedure. Fabricius ab Aquapendente recommended suspending the patient by hands and feet, with the head dropped backwards and the pelvis raised higher than the thorax and in addition thorough shaking of the swinging patient. Corvillard suspended his patient by the legs. Sharp employed an attendant who supported the patient on his back in such a manner that the legs were drawn over the carrier's shoulders on which the popliteal spaces of the patient rested. The carrier also had to shake the patient. Ribas employed a similar method. Freund (*Volkmann's Sammlung klin.* No. 133) extirpated a carcinomatous uterus in 1878. . . .

Personally I first employed high pelvic elevation in bladder surgery (in 1880) for the purpose of exposing the interior of the bladder to daylight and optic inspection after opening the bladder by suprapubic cystotomy. My method is quite independent of Freund's report. I had in mind rather the principle of the Sim's posture (1845) where the vulva is the most elevated point of the body and the opened vagina admits the air



because of negative intrapelvic pressure and thus becomes distended. Similarly I intended to admit air into this opened bladder. Sometime later I realized the great advantage of the posture in suprapubic cystotomy and it was quite natural to employ it also in laparotomy. Since 1884 I have been using high pelvic elevation in every suprapubic cystotomy; since the winter of 1887-1888 I have used it in every laparotomy for intrapelvic surgery. Not a single term has passed without my demonstrating either of these operations by the above method. . . .

There is little to say on the technic of high pelvic elevation. In the beginning I stationed an attendant at the head of the operating table and suspended the patient's knees over his shoulders in much the same way the early surgeons used in hernial surgery. For some time I have now used a support especially designed by Eschbaumn and fixed to the head of the operating table. Eschbaumn exhibited it at the meeting of the *Naturforscher* at Cologne in 1888. The operation should be started only after narcosis is established and pressure or forced respiration has subsided. During operation deep narcosis should be maintained and it is usually not unfavorably affected by the low position of the head. The thinner the individual and the more empty the intestines the more obvious are the advantages of the posture.

TRANSLATION OF ARTICLE BY DR. WILLY MEYER REGARDING THE  
TRENDLENBURG POSITION

AFTER-TREATMENT IN SUPRAPUBIC CYSTOTOMY AND ITS APPLICABILITY IN THE SURGERY OF VESICOVAGINAL FISTULA

We shall briefly describe the posture of the patient which Professor Trendelenburg has employed for some time in operations of the inner aspect of the bladder. The appended sketch by Dr. Sticker (see woodcut p. 514) demonstrates that the patient (after opening of the bladder) is completely turned about. The head lies very low, the buttocks and pelvis are raised high and rest on the edge of the supporting end piece. The legs of the patient are flexed at the knees and in this position are placed respectively over the shoulders of an attendant, who turns his back to the operating table, and firmly holds the patient's legs. In consequence the intestines follow the law of gravitation and drop down in the direction of the diaphragm, the incised bladder opens—similar to the behavior of the vagina in the Sims' position—and permits not only a perfect survey of the interior of the bladder but also, after retracting the edges of the abdominal and vesical wounds with broad blunt retractors—the large von Langenbeck resection hooks are probably most suitable—or after holding back the wound edges by a loop of thread respectively, permits the introduction of all instruments required for removal or any other surgical methods. This posture especially permits a good survey of the *trigonum lieutandi*, the spot where vesical tumors are most frequently found inserted. If the foot end of the operating table faces the window, as is usual, the daylight directly shines into the lower posterior section of the bladder, and brings plainly into view not only the internal opening of the urethra but also the area where the ureters open. Thus observations can be made that are impossible in the "usual dorsal position."

QUESTIONNAIRE

1. Define chylous peritonitis, chyliform peritonitis, hemoperitoneum, choleperitoneum.
2. What are the chief causes of hemoperitoneum; the clinical picture?
3. What is meant by the leucocytosis following hemorrhage; by the leucocytosis of subserous hemorrhage?

4. Describe the leucocytic reaction following bleeding beneath serous membranes; plot the typical leucocytic curve.
5. What are the signs and symptoms of bile peritonitis?
6. What are the common causes of leakage of bile into the peritoneal cavity?
7. How can chylous and chyliform ascites be differentiated?
8. What are the chief causes of chylous ascites? How may this diagnosis be established?
9. What are the clinical findings with acute perforation of a peptic ulcer?
10. What conditions predispose to an intraperitoneal extravasation of urine?
11. What is the relationship between fractures of the pelvis and injuries to the bladder?
12. Name some of the methods for making a diagnosis of intraperitoneal urinary extravasation.
13. Is the bladder a pelvic or an abdominal organ?
14. Classify the causes of ascites.
15. What is the origin of ascitic fluid?
16. What percentage of cases of ascites is due to cardiac disorders?
17. What are the most common intra-abdominal conditions causing ascites?
18. What clinical evidence points to cardiac disease as the cause of ascites; to renal disease?
19. Describe the clinical evidence of cirrhosis of the liver.
20. What are the forms of tuberculosis of the peritoneum?
21. What percentage of cases of tuberculous peritonitis shows accumulations of ascitic fluid?
22. Give the clinical evidence pointing to the diagnosis of ascites due to tuberculous peritonitis.
23. What is meant by the Virchow-Troisier gland?
24. What is the significance of an enlargement of the left supra-clavicular gland in association with ascites?
25. Describe the clinical picture in a typical case of malignant peritonitis.
26. How often is malignant peritonitis a primary condition?
27. What are the most common sites of primary malignant growths which give rise to a secondary malignant peritonitis?
28. Name the most important large veins found within the abdomen.
29. What is the significance of jaundice associated with ascites?
30. What is the most common cause of ascites in children, in adolescence?
31. When edema of the legs precedes ascites, what is the most common cause of the latter?
32. What is the most common cause of ascites when this is associated with edema of the face and upper extremities?
33. What is meant by the term "intra-abdominal pressure?" What is this pressure in terms of millimeters of mercury or centimeters of water?
34. What is the normal pressure within the abdomen? Is it atmospheric, below or above that of the atmosphere? Give proofs.
35. In what respects are the pressure conditions within the abdomen similar to those within the thorax? In what respects are they different?
36. What is the basic factor which makes possible a subatmospheric pressure within the pleural cavities? Are conditions similar in regard to the abdomen?
37. What is the derivation of the word chest and the word belly? What fundamental functional differences are implied in these derivations?
38. What precaution must be taken in applying a plaster-of-Paris jacket which covers the abdominal walls? Why?

39. What is a scaphoid abdomen?
40. What conditions cause a scaphoid abdomen? What force or forces explain the shape assumed by the abdomen in this condition?
41. What is meant by the S-shaped or Gourd-shaped abdomen? Give the most common causes of this condition.
42. By what mechanism is the general pressure within the abdomen stabilized?
43. What is the effect upon the general intra-abdominal pressure of a sudden contraction of all the muscular walls?
44. Name some of the uses of the cough reflex for diagnosis.
45. What mechanical factor sometimes leads to dyspnea in certain abdominal disorders?
46. What is a phantom tumor? What is aerophagia?
47. What is the Murphy test for acute diseases of the gall bladder? Explain the mechanism of this sign.
48. When may it be of aid to palpate the abdomen with the patient in the knee-elbow posture?
49. Discuss the technic of abdominal palpation.
50. What is meant by the enteroabdominal reflex?
51. Why does not the injection of a given amount of air or fluid into the abdominal cavity have the same effect upon intra-abdominal pressure as the injection of the same amount of the same substance into the enteral canal?
52. What is the effect upon systemic blood pressure of a rise in the general intra-abdominal pressure?
53. What are the effects upon the abdomen of the subatmospheric pressure normally present within the pleural cavity?
54. Why is the diaphragm dome-shaped?
55. Give some proof that the pleural cavities exert some upward pull upon the abdomen.
56. Explain the obliteration of liver dullness.
57. Why is shoulder pain so frequent an accompaniment of free fluid or gas within the peritoneal cavity?
58. What effects do the thoracic movements have upon the general pressure within the abdomen?
59. Explain how it is possible for the pressure within the upper part of the peritoneal cavity to be lowered during the act of inspiration.
60. What are the various types of breathing?
61. What effects do these types of breathing have upon pressure variations within the abdomen?
62. What is the effect upon the circumference of the upper abdomen of a forceful inspiration with the thoracic type of breathing?
63. In what part or parts of the abdomen is subatmospheric pressure a normal condition?
64. In what part or parts of the abdomen is a positive pressure a normal condition?
65. What conditions tend to increase the pressure negativity within the abdomen? What conditions tend to increase the intra-abdominal pressure?
66. At what phase of the respiratory cycle is it most safe to incise the upper abdominal cavity (open the peritoneum)?
67. What is meant by intraluminary pressures? Intravisceral pressures? Static pressures? Illustrate.
68. What effect has a change in intravisceral pressures upon intraperitoneal pressures?
69. By what routes are intestinal gases normally disposed of? Give the approximate percentage eliminated through each route.

70. What is the effect upon the intestinal tract of an obstruction to the intestinal lumen?
71. Name some reasons why interference with the blood supply to the bowel leads to distention of the bowel.
72. Explain why gas may accumulate within a strangulated loop of bowel.
73. Why is distention of a viscus more dangerous at one time than at another?
74. What is the effect of a sudden release of an elevated intra-abdominal pressure?
75. What precautions must be taken to prevent circulatory disturbances after the removal of a large ovarian cyst?
76. What dangers are there in suddenly emptying the bowel by means of ileostomy, when the bowel is markedly distended in the presence of an acute peritonitis?
77. What is the effect upon the bowel of blocking the splanchnic nerves by a local anesthetic agent?
78. What is a gastromesenteric ileus?
79. Give the outstanding triad of symptoms of gastromesenteric ileus?
80. What is the accepted treatment for acute gastromesenteric ileus?
81. Explain the reasons for washing the stomach and for changing the posture of the patient with mesenteric ileus.
82. After what operations is a gastromesenteric ileus most common? What is the mortality after prompt treatment; with no treatment?
83. What may be done to facilitate an exploration of the abdomen when the intestines are markedly distended with gas?

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## COMPLICATIONS OF SPINAL ANESTHESIA\*

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IN reviewing the literature on the complications of spinal anesthesia it was found that in most instances phenomena that are part and parcel of the *modus operandi* of the anesthesia, that are but temporary in nature and that despite their unpleasantness are in no way a menace to future health or life are included as definite complications. Inasmuch as these so-called complications, to wit, the fall in blood pressure that is so frequently unnecessarily alarming to the anesthetist or surgeon, the nausea, retching or even vomiting of the patient within a few minutes after the injection of the anesthetic, the pallor, at times associated with a cold, disconcerting clamminess of the skin, and the enfeebled pulse, often barely perceptible, inasmuch as these so-called complications are by far the most frequently mentioned, and since they form the basis of a great deal of the objection that has been raised against the routine employment of spinal anesthesia, it seemed appropriate to present a paper with the subject of complications as its main theme.

A rather comprehensive survey of the literature was undertaken. Over two years of research were devoted to the subject and articles dealing with intraspinal anesthesia since its very inception were studied. The English, French, German, Spanish and Italian journals were searched for material. Inasmuch as the bulk of medical

literature finds expression in one of the foregoing languages a rather conclusive symposium was available. In view of the low incidence of complications following the use of intraspinal anesthesia as reported in these journals it seems fair to state that the injection of an anesthetic substance into the subarachnoid space preliminary to surgical intervention has been given the test of time and quantity and has been found to be exceptionally low in either frequent or serious sequelae.

Articles dealing with the subject have been reported on the completion of a series of cases ranging from 100 to 20,000 intraspinal injections. Most frequent mention is made of headache. Less frequently, reference is made to symptoms that are classified as meningeal in origin, being the result of either a meningismus or, even more rarely, a true meningitis. Occasional reference is made to the appearance of neurological disorders as, for instance, paresthesias, myelitis, anal and vesical incontinence, paralysis of the external rectus muscle of the eye, and tropho-neurotic disorders ranging from decubitus ulcers to a well-marked paraplegia. Mental aberrations varying from a mild psychosis to pronounced insanity have been recorded as sequelae. Syncope, coma and respiratory failure have been noted. The increasing popularity of subarachnoid injection as a means of inducing surgical anesthesia has stimulated the reports of accidents

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that have occurred as a result of lumbar puncture in itself. Indeed, an appreciable percentage of the fatalities that have occurred immediately after the injection of the anesthetic has been attributed to what some authors have seen fit to designate as "lumbar puncture shock."

#### HEADACHE

The most troublesome complication of spinal anesthesia is the occurrence of headache. The majority of patients thus afflicted begin to complain as a rule within the first twenty-four hours after the operation. Usually, the headache is either occipital or parietal in location and is frequently associated with some degree of stiffness of the neck muscles. The intensity varies. In most instances the discomfort is so mild that the administration of either aspirin or pyramidon or the application of an ice cap suffices. Rarely is the suffering of such great intensity that the usual analgesics are of no avail. In both the mild and the severe grades the headache is worse when the head and shoulders are raised. Relief is usually obtained in the former type by maintaining the horizontal position.

Headache is not only the most troublesome complication of spinal anesthesia but it is also the most frequent. According to the reports that have appeared in the literature the average incidence ranges in the neighborhood of 20 per cent. As high as 40 per cent, however, has been encountered. Mahler<sup>1</sup> in an experience of 1000 intraspinal anesthetics mentions but 10 per cent of headaches and calls attention to as high a proportion after simple diagnostic lumbar puncture. In the main these headaches disappear within twenty-four to seventy-two hours. The severe, agonizing, persistent type that resists the ordinary analgesics is rare. Indeed, in our own series of over 6000 cases their incidence has been no greater than 600, in other words, 10 per cent.

Featherstone<sup>2</sup> sent inquiries to 100 consecutive patients to whom he had

administered spinal anesthesia with the aid of tropococaine. Not one complained of serious disability that in any manner could be charged against the method of anesthesia. Headache and dizziness were the most frequent sources of complaint. Of 70 replies, some degree of late headache was said to be present in 28 cases, that is to say 40 per cent. One man complained; the remainder were women. He adds:

Astonished by the high incidence of the trouble, I wrote to 20 patients who, under general anesthesia, had undergone operations of a similar nature to those suffering from late spinal headache. There were 16 replies, and in 11 of these the patients had a headache. Thus, of those who under general anesthesia had undergone operation for conditions likely to cause headache, 68 per cent did in fact develop late headache. I think I am justified in blaming the patient's complaint rather than the spinal anesthetic for this late headache. Giddiness did not occur in those patients who were otherwise robust.

In our clinic the administration of spinal anesthesia is not limited solely to so-called poor surgical risks. In fact, save for such short procedures as the incision and drainage of an abscess and the like, subarachnoid block is induced routinely. It has been interesting to observe with what irregularity so-called spinal headache occurs. Frequently, a series of 100 cases, operated upon for varied surgical conditions, comprising all age groups and both elective and urgent conditions, poor risks and doubtful risks, will include but 2 per cent of mild headaches lasting no more than two or three days and amenable to the usual analgesics. In such a series the absence of agonizing headache will be noticeably in evidence. Then, again, a second series may contain as high an incidence as 20 per cent of the mild headaches and may show perhaps 1 or 2 or even 5 per cent of the more severe grade necessitating methods of treatment other than those ordinarily required. We have encountered marked headache that has persisted for more than one week

and that has recurred after temporary relief so that the duration of the affliction may be said to have existed for several weeks in but 5 instances out of a total number of inductions that at the present writing is as high as 6000 cases.

As is to be expected much theorizing has been done in an effort to explain the cause of this type of headache. Among the several ideas advanced are the following:

1. Loss of cerebrospinal fluid through the puncture wound in the dura by seepage into the extradural soft tissues.

2. An increase in the volume of cerebrospinal fluid contained within the subarachnoid space.

The mechanism of occurrence in the first instance has been ascribed to the lack of elastic and contractile tissue in the fibrous dural membrane. It is believed that the puncture hole caused in the dura by the needle point does not close until a fibrin clot forms or normal healing takes place. Castro Silva<sup>3</sup> states that it has been his lot to perform laminectomies eight or fifteen days after a lumbar puncture and to find the tracts of the puncture still gaping, closed simply by non-adherent, epidural fat.

Upon the withdrawal of the needle, the dura and the underlying pia-arachnoid are left in one of two possible relations. Either the openings in the two membranes are superimposed, if the pia is drawn back through the dural opening by the needle, allowing leakage to take place or else the movement of the soft membranes upon each other causes the openings in the respective membranes to be situated at different levels. The force of the cerebrospinal fluid is then thought to compress the pia arachnoid against the dura for an interval long enough to permit the pial opening to close by virtue of its inherent elasticity. If the latter mechanism takes place very little cerebrospinal fluid will escape.

As a result of the considerable seepage of spinal fluid during the first few hours

after the operation, there is a disturbance of the intracranial portion of the cerebrospinal fluid. It has been claimed that the latter factor, by removing the watery cushion, allows the brain to sag against the bony framework of the skull. This in turn, supposedly, irritates the dural fibers of the trifacial and the two occipital nerves. Pressure upon the basilar venous plexus diminishes the outflow of venous blood from the cranial cavity and brings about an increase of venous tension. Lowering the patient's head is thought to remove the brain from contact with aforementioned nerves and venous plexus and thus tend to lessen the severity of the headache. Relief is similarly obtained when the opening in the dura has closed, seepage of fluid has ceased, and the normal watery cushion of the brain has been restored.

This type which may be referred to as the seepage type of headache is ascribed ordinarily to the lumbar puncture itself. The second variety of headache, however, is thought to be the result of an increase in the quantity of cerebrospinal fluid. Usually, other symptoms and signs are associated as, for instance, stiffness of the neck, photophobia, and more rarely, paralysis of the external rectus muscle of the eye with or without a concomitant diplopia. This syndrome is described as the postanesthetic meningitis or meningismus. Whereas in the former variety, the spinal fluid pressure may be very low, there is usually found an increase in the pressure associated with an increase in the cells and globulin constituents of the cerebrospinal fluid in those patients with meningismus. Thus, either a state of meningeal irritation is present or else, rather infrequently, a true infectious meningitis. Such headaches do not respond to the lowering of the patient's head.

Unfortunately, the literature is considerably at variance as to the cause of headache after either diagnostic lumbar puncture or after the intraspinal injection of an anesthetic. Burrus<sup>4</sup> like many others attributes the headache to leakage and con-

demns the larger caliber needles because more fluid can escape through the larger opening and healing is proportionately delayed. We ran a series of over 300 cases with a fine caliber needle and found no appreciable change in the incidence of headache. According to Evans<sup>5</sup> this seepage type of headache is associated with a diminished pressure and he counsels against a further lumbar puncture "as it will make this type of headache worse." Valdome<sup>6</sup> on the other hand, reporting an incidence of 30 per cent (tutocaine anesthesia), after stating that he considered the loss of cerebrospinal fluid as the cause of headache, employed secondary lumbar puncture in 8 cases that failed to respond to caffeine, aspirin or pyramidon and concludes that his contention seemed "to be proved by the fact that the pressure of the cerebrospinal fluid was lowered." An interesting statement is that of Pardee who, after hearing Neustaedter, Hola and Tolstoochow<sup>7</sup> report that they could find no definite relationship between the calcium content of spinal fluid and postlumbar headache, stated that he saw no reason for ascribing headache to leakage since, in his experience, it has been possible to "take out as much as 80 c.c. from the spinal canal and still have no spinal puncture headache even though the patient may get up immediately afterward." After reading such a statement, one becomes rather perplexed upon studying the recommendations of Wells<sup>8</sup> for the technic of inducing spinal anesthesia with what he refers to as anhydrous cocaine.

We quote verbatim from his report as follows:

From 15 to 25 c.c. more of spinal fluid are then withdrawn from the spinal canal into a glass syringe using gentle traction on the plunger. The amount withdrawn is determined by the patient's reaction, which consists of a progressive headache, generally occipital. In the early part of the series we allowed the headache to go on until the patient uttered an involuntary high-pitched cry, but this has been found to be unnecessary. We now deter-

mine the part where headache starts and then continue to withdraw fluid slowly, stopping when we judge that the headache has reached the maximum.

The entire quantity of cerebrospinal fluid contained in the syringe with the dissolved anhydrous cocaine is then quickly reintroduced into the subarachnoid space and "immediate and complete cessation of headache takes place."

It is interesting to note that headache was not frequently encountered by Delmas,<sup>9</sup> one of the foremost French exponents of spinal anesthesia, despite his technic which makes a particular point of first abstracting from 20 to 40 c.c. of fluid, employing barbitage to dissolve the anesthetic substance and increase the diffusion in order to induce whole body anesthesia.

The question of the treatment of headache is discussed from both the prophylactic and curative standpoints.

#### PROPHYLAXIS

The following recommendations have been made:

1. Use a small caliber needle.
2. Do not allow the patient to move or elevate the head while being operated upon and for several hours after the injection of the anesthetic.
3. Administer sufficient fluids preoperatively. According to Martin-Arbuthnot<sup>10</sup> the patients on the urological ward of the Los Angeles General hospital have their black coffee and all the water they wish to drink before going to the operating room. Those on the general surgical service have their routine surgical preparation and no fluids by mouth on the morning of the operation and it is among the latter group that dull, frontal headaches are encountered. They recommend, therefore, that there be no restriction in the amount of fluids before operation.
4. Avoid the reintroduction of the spinal puncture needle. Careful attention to the technic of lumbar puncture will minimize

dural trauma and thus lessen both the incidence of leakage and the occurrence of irritative phenomena.

5. Do not inject air into the subarachnoid space or puncture the venous plexuses that surround the anterior and lateral aspects of the spinal column. Featherstone<sup>2</sup> remarking that the French have blamed the injection of air, points out that headache occurs after simple lumbar puncture where it is difficult to imagine how air could enter the subarachnoid space. Nor can we ascribe much importance to the few bubbles of air which we frequently inject since from 60 to 80 c.c. and even more are routinely injected in ventriculography without either routine severe headaches or disastrous results. Bagley<sup>11</sup> has endeavored to blame the incidence of headache in intracranial injuries upon the presence of blood in the subarachnoid space. Believing that this might be a clue to the causation of headache, we have paid particular attention to those patients in whom a bloody tap was obtained. At no time did we hesitate to inject the dissolved anesthetic provided that spinal fluid was obtained after the venous plexus had first been punctured accidentally. Such patients did not show a greater incidence of headache.

#### CURATIVE

1. Administer the usual analgesics first: aspirin, caffeine, phenacetine, pyramidon. Codeine or even morphia may be indicated.

2. Advise the patient to maintain a horizontal position and apply an ice cap to the head.

3. Darken the room, especially if photophobia or diplopia be present.

4. Eliminate all forms of stimulation (including too many visitors that may be productive of unnecessary excitement).

5. Administer 1 c.c. of either surgical pituitrin or from  $\frac{3}{8}$  to  $\frac{3}{4}$  of a grain of ephedrine hydrochloride intramuscularly.

6. In the seepage type of headache administer about 100 c.c. of 0.5 per cent sodium chloride solution intravenously.

Relief will come within twenty to forty minutes (Evans). Also, force fluids, using a Murphy drip if necessary.

7. Frequent lumbar punctures are advised for the type of headache associated with an increased spinal fluid pressure and meningismus. This procedure is to be resorted to only after relief has not been obtained from diuretics, cathartics and hypertonic saline solution both orally and intravenously. According to Evans<sup>4</sup> the intravenous administration of 10 per cent glucose solution in physiological salt solution will relieve this type of headache if nothing else will. As much as 1000 c.c. may be given and it may be repeated after six to eight hours.

Early in our experience, we adopted one of the procedures that had proved of value in the treatment of increased intracranial pressure. Retentive enemata of 6 oz. of 50 per cent magnesium sulphate solution were prescribed. Usually, 1, 2 or 3 rectal injections at intervals of four hours were sufficient to relieve the mild forms of headache that did not respond to the ordinary analgesics and that were not severe enough to warrant a secondary lumbar puncture.

Recently, since some of the patients found it difficult to retain the solution for a time sufficient to allow of any therapeutic value and in some instances a mild proctitis developed, we adopted the intramuscular injection of 2 c.c. of 50 per cent magnesium sulphate as supplied in ampule form for the Gwathmey technic in obstetrics. A fair measure of successful results ensued. We accidentally discovered the increased efficacy of the drug when administered intravenously. A patient had already received one retentive enema which she had not retained satisfactorily and which had failed to relieve her of intense headache, stiffness of the neck and marked photophobia. Within several seconds after an intravenous injection of magnesium sulphate, she experienced a sensation of extreme warmth, perspired freely and became quite dry

in the mouth. Two minutes later, she gratefully stated that all her symptoms had miraculously disappeared. Other similar experiences have since established this as a rather reliable agent in our therapeutic armamentarium. Now, when we receive a complaint of slight headache, the patient receives a coal-tar preparation, usually aspirin. Moderate headache is treated by magnesium sulphate intravenously. Severe headache unrelieved by magnesium sulphate is invariably cured by one or two spinal punctures. In one instance, peculiarly enough, a nurse upon whom a cholecystectomy and appendectomy had been performed, cure was not effected even by repeated spinal taps. The empirical use of  $\frac{1}{2}$  grain each of anterior pituitary and thyroid gland extracts produced an almost immediate cure.

It seems quite evident that there is still considerable information to be secured regarding the mechanism of the production of headache. Apparently, in most instances the caliber of the needles, blood in the spinal fluid, the injection of air and seepage are explanations which do not hold water. It is evident that in a fair proportion of cases, increased intracranial pressure (however produced) is an important factor.

#### BACKACHE

Backache occurs in a small percentage of cases. It may be due either to trauma of the soft parts that are traversed by the needle, especially when several attempts to enter the subarachnoid space have been made, or else to a serous meningitis resulting from the wound in the dura and pia, the liberation of a small quantity of blood by accidental penetration of one of the venous plexuses, or the introduction of rust particles from the needle, or even from the presence of several bubbles of air. No matter what the cause may be, the backache is but short in duration and is frequently relieved by placing a pillow under the small of the back.

In our experience, the incidence is approximately 2 per cent. It has never proved very troublesome nor has it ever persisted longer than a week. This period coincides with the time required for the repair of the local tissue-injury. In no instance that we know of has local supuration resulted, the tissues always being able to complete the reparative process without necrosis. The backache resulting from the induction of anesthesia must not be confused with that following the dorsal recumbent position on an operating table not fitted to conform to the curve of the spinal column. The former quite accurately can be localized to the site of the puncture; whereas the latter is a more diffuse ache.

The only treatment necessary is a local wet dressing and control by coal-tar depressants, although the former has been resorted to in only one instance in our series.

#### ANAL AND VESICAL DISTURBANCES

Often reference is made to anal or vesical incontinence as a possible complication. Most authors, however, remark that they did not encounter such a state of affairs or else an occasional case appeared wherein reestablishment of the normal functions required but several days to a week. Orth<sup>12</sup> for instance, reports a case of fecal incontinence that cleared up spontaneously after five days and Izquierdo<sup>13</sup> one that persisted for a week. In Bazy's patient<sup>15</sup> the fecal incontinence was due to the fact that sensibility of the anus had been lost. The need of evacuation was experienced as a peculiar sensation in the region of the pubis. Even after the patient had moved his bowels, he still had a sensation of fullness in the rectum.

On the third day after a double inguinal herniotomy under 0.12 gm. of stovaine, a patient of Sourasky<sup>14</sup> developed urinary incontinence, that is, retention with overflow. This was soon followed by occasional fecal incontinence. Fully a year elapsed before complete restoration of functions

appeared. In a second case, an appendicular abscess in a boy of nineteen, incontinence disappeared at the end of three weeks.

Salleras<sup>15</sup> operated upon a boy of seventeen for acute appendicitis who shortly afterward developed a marked vesical retention. The bladder would distend so that it could retain 800 c.c. of urine without any discomfort to the patient. Incontinence resulted from the overflow. Fecal incontinence was also present as well as exaggerated knee jerks, hyperactive tendo Achilles reflexes, ankle clonus and a positive Babinski reaction. This state, however, lasted only three weeks. Salleras advanced the theory that the medullary centers of defecation and urination had suffered damage as a result of a local irritation of the meninges. The latter gave rise to a meningitis which caused a compression of the area either by the increased quantity of cerebrospinal fluid formed in response to the irritation or by the presence of hemorrhage into the subarachnoid space brought about by the trauma of the needle or else damage to the centers resulted from the onset of a sclerosis.

A most interesting case has been presented by Vialard and Darleguy.<sup>16</sup>

A few days after an appendectomy under syncaïne intraspinal anesthesia, from 19 to 23 liters of clear urine were passed daily. Kidney function tests were normal. Physical examination was negative except for a sickly habitus. There was a negative urine save for a specific gravity of 1.001 to 1.002. The spinal fluid and Wassermann examinations proved normal. Several levels of hyperesthesia existed to wit, the trigeminal, C 7 to D 1, D 4, D 5, D 8, D 12, and L 1. Deep sensibility was normal.

Signs of adiposis dystrophia genitalia were not evident. The patient acknowledged, however, that he had suffered for some time from a slight trembling which was especially marked in the upper extremities. Following the onset of the polyuria, the patient lost considerable weight. When not eating or drinking because of anorexia, the trembling was exaggerated. It consisted of small, irregular, myoclonic

movements. Fibrillary twitchings were absent. The hands were cyanotic.

Roentgen examination of the sella turcica revealed apparently normal findings. And, also, a psychological examination was negative. The initial thirst became imperative and, when unable to satisfy this thirst, despite the fact that nothing was discernible, he complained of a sensation of swelling of the tongue and lips with itching and even painful smarting.

Urinary elimination did not accurately correspond with the intake, although retention of fluid in the tissues did not take place. The rate of elimination was influenced to some degree by position. Thirst was greater at night and the nightly output was from two-thirds to three-fourths greater than the daily excretion. On days when he was unable to leave his bed, however, the daily output was equal to the nocturnal. He complained of intermittent frontal and occipital headaches that were less intense while he was lying in bed. General feebleness and increasing anorexia appeared. Finally, he presented a typical attack of Jacksonian epilepsy with aura in the calf of the right leg.

Upon discharge from the hospital, his urine output was 20 to 23 liters a day and his weight was one-half that on admission.

On examining the family history, it was discovered that there had been a brother who had died as a result of meningitis at the age of three months. The patient himself had suffered from convulsions at the age of three months and some few weeks previous to admission had had a so-called nervous breakdown. Presumably, according to these authors, both had had during infancy a meningitis that caused the death of one and left latent sequelae in the other. The latter might well have been responsible for the nervous manifestations and for the seizure of Jacksonian epilepsy. Furthermore, there quite likely existed a meningeal plaque at the base of the brain.

According to the same authors, the work of Lhermite, de J. Camus, and Roussy as well as that of de J. Camus, Gournay and Legrand has demonstrated clearly that there exist groups of fibers in the tuber cinereum, the one regulating the metabolism of carbohydrates, the other the retention of water in the organism. The nucleus proprius of the tuber cinereum (situated superficially) would be the center of nerv-

ous polyuria. It is easy to conceive of the causation of the infundibulo-tuberien syndrome (nervous polyuria) resulting from a meningeal lesion limited to the base of the brain near the posterior aspect of the tuber cinereum. The lumbar puncture may have reactivated the latent meningitis either through the direct action of the injected anesthetic or more likely by simply disturbing the equilibrium of the dynamics of the cerebrospinal fluid. The intraspinal injection of sterile water or even of normal saline solution is followed by after disturbances as shown by the experiments of Guinard and Koslowski, later confirmed by Stolz and Schwartz.<sup>17</sup>

Bazy<sup>18</sup> reported a case of herniotomy in a man of fifty-nine who for eighteen months after the operation experienced no desire to urinate. When the desire had finally returned, spontaneous contraction of the bladder failed to appear. Catheterization was necessary for the entire eighteen months. After progressive education of the abdominal muscles, catheterization was at last suspended at the end of two years. Still his difficulties were not at an end since, despite his ability to urinate normally at the beginning of his apparent restoration, he was later obliged to assume a crouching posture. Involuntary urination would take place if he neglected to void for from six to eight hours.

The necessity of catheterizing patients postoperatively occurs in 10 per cent of our cases. Of this number 90 per cent need only one or two catheterizations and the remainder void spontaneously after the third day.

In no instance did retention last longer than the stay in the hospital necessary for wound healing. Never did it last longer than ten days, expecting in the instance of a case at present still in the hospital. The patient, a male, forty-seven years old, was operated three weeks ago for carcinoma of the rectum. A bilateral inguinal gland excision and a transsacral extirpation of the rectum were performed. The patient has not as yet voided spontaneously. The urine

is clear. The bladder becomes distended so that the patient becomes uncomfortable and requests relief. At the operation there was no evidence of injury to the urethra or bladder wall. This urinary retention is the only complication presented by the patient.

We have given some thought to the possibility of a postoperative traumatic prostatic enlargement as the possible etiological factor and expect to receive more information by cystoscopic examination.

It is our impression that postoperative urinary retention is much more frequently encountered after inhalation narcosis.

Of all the cases presenting this complication, 75 per cent occurred after operations involving the perineum or pelvis or both. We rarely encounter vesical disturbances in head, neck or thorax operations.

It would seem therefore, that invasion of the pelvis either directly or indirectly through the medium of the upper portion of the peritoneal cavity to a lesser degree, predisposes to retention. Of course, perineal operative trauma is readily recognized as a responsible factor.

The hypothesis that the anesthesia induction produces a localized serous meningitis and thus disturbs the anal and vesical spinal centers in the lumbar region of the cord is contradicted by the statistical evidence demonstrating the greater frequency of retention following inhalation anesthesia.

In discussing vesical complications it might also be mentioned at this time that, frequently, following the anesthesia induction in a patient just catheterized, upon opening the abdomen the bladder may be found full. It was formerly assumed that the catheterization had been incomplete; but recent observations on kidney secretion following splanchnic section have presented a satisfactory explanation. It is found that splanchnic section or block results in the simultaneous activity of all the kidney glomeruli. Normally, part of the glomeruli rest while others function. With all of them active during any given time, urinary secretion is tremendously increased. Apparently,

glomerular activity is continuously controlled by impulses coming through the splanchnics. Spinal anesthesia which is high enough to block all the splanchnic influences (i.e., roots of the fifth to the twelfth dorsal and first and second lumbar nerves) abolishes this control and increased secretion results.

Treatment of this complication is limited. Catheterization is essential. Stimulation of the lumbar cord by the administration of strychnine and caffeine seems of little value. The influence of pituitrin on the bladder musculature is unreliable. The instillation of glycerine into the bladder has never been of value in our series. We have had no experience with electrical stimulation of the lumbar cord. We have found enemata second only to catheterization as a means of emptying the bladder. Nor do we hesitate to order them the first day after operation excepting in cases of colonic or intestinal resections or anastomoses.

We have had one experience with vesical incontinence directly referable to the anesthesia. This occurred in a female patient operated on for uterine fibroids. For the first eight days, she voided spontaneously. On the ninth day, it was reported that she was incontinent. Examination revealed a distended bladder reaching almost to the umbilicus. Fifty-two ounces of urine were obtained on catheterization. Following this, spontaneous urination reappeared.

No case of fecal incontinence has come to our notice.

#### OCULAR COMPLICATIONS

The literature contains but few references to the occurrence of ocular complications after intraspinal anesthesia. These are practically limited to paralysis of the extraocular muscles, usually to the external rectus which is supplied by the abducens or sixth nerve. Although ocular disturbances have set in from several days after the injection to as late as the second week after operation, cases have been reported wherein they occurred immedi-

ately following the lumbar puncture. As a rule, the complication, although unpleasant, proves to be transitory. After a maximum effect lasting from one week to ten days, the condition shows signs of beginning cure. Occasionally, complete cure does not take place until two months have elapsed.

Abducens paralysis is usually ushered in by a preliminary photophobia. Diplopia supervenes and is homonymous. Outward motion is limited and there is convergent squint. All these symptoms are exaggerated as the patient attempts to abduct the affected eye. Reber<sup>19</sup> reported 5 cases of transient abducens palsy from the service of Babcock. These appeared after the use of ampules of stovaine and tropococaine that had been imported from Europe. The paralysis became evident seven days after operation. Both Reber and Babcock believed that infection followed the employment of contaminated solutions since no similar complication was encountered during the next eighteen years, during which period over 20,000 spinal anesthetics were administered. Valdoni<sup>20</sup> adds 3 cases in 500 inductions with 2 per cent tutocaine. Gagey<sup>21</sup> reports 1 instance in 700; while Warnecke<sup>22</sup> lists 8 in a series of 1800. Gagey's patient suffered from diplopia for two months; whereas the condition subsided completely in Warnecke's patients after the lapse of several days. Two cases were reported by Tits,<sup>23</sup> one four days and the other six days after the injection of 15 cg. of allocaine. Both, however, proved to be transient. Van Duyse fils<sup>24</sup> referred to 4 further cases similar to those of Tits. In one of his patients the paralysis of the abducens appeared shortly after the intraspinal injection but disappeared entirely at the expiration of several days. In another, however, ten days passed before any indication of ocular disturbance became evident nor did the patient begin to show the slightest sign of improvement until two months later. Satanowsky<sup>25</sup> adds one transient case of abducens palsy.

A functional optic neuritis occasionally accompanies abducens palsy. There is a



disturbance of vision, sometimes insignificant, at other times, rather marked. The degree of disturbance is not always proportionate to the degree of changes seen on ophthalmological examination. There may even be complete blindness, though temporary, as reported by Wells.<sup>26</sup> This alarming complication occurred in one instance out of a total of 557 cases by Wells after the use of anhydrous cocaine. Fortunately, the patient recovered completely at the end of five days of grave concern. Functional optic neuritis appeared in one of Tits' patients but vanished after several days.

Reboj<sup>27</sup> states that he has never encountered any case of choked disc as reported occasionally in the literature of spinal anesthesia. According to his views the infrequent paralysis of the trifacial, common oculomotor and external oculomotor nerves, and pressure on the optic nerve (choked disc) can be explained by hypertension of the cerebrospinal fluid consequent to a serous, toxic meningitis caused by the injected anesthetic agent. He recommends that decompressive lumbar punctures be instituted as soon as these signs appear.

Drooping of the left upper eyelid (the result of a paralysis of the branch of the oculomotor nerve which supplies the levator palpebrae superioris) was reported by Wells.<sup>26</sup> This disappeared at the end of two weeks and was encountered in but 1 case. Martin and Arbuthnot<sup>28</sup> in a review of over 6000 cases operated on under spinal anesthesia at the Los Angeles General Hospital mention but 1 ocular complication, an inability to move the eyeballs without causing intense pain. This was accompanied by numbness of the feet which persisted for two days, severe headache and neck pain that lasted for three days.

When paralysis of the external rectus occurs, it is usually unilateral, and as frequent in the right as in the left eye. It does however, occur bilaterally as reported by Lang,<sup>29</sup> Baisch,<sup>30</sup> Goettermann<sup>31</sup> and Landow.<sup>32</sup>

The majority of authors who have reported ocular complications after intraspinal anesthesia point out that one must not be too prone to consider the anesthetic at fault since similar disturbances occur at times following lumbar puncture alone. Guillain and Alajouanine and La Grange<sup>33</sup> have observed papillary hyperemia in patients who displayed other signs and symptoms of lumbar puncture intolerance, such as, headache, nausea and vomiting. Examinations previously showed normal eyegrounds. The papillary picture was remarkably constant and persisted several days after the subsidence of the other symptoms. In patients who complained of headache, vertigo and nausea of only several days' duration the ophthalmological picture showed only a congestion of the papilla without all the signs of a true papillitis. When no evidence of lumbar puncture intolerance was obtained, no ophthalmological changes occurred. Guillain and Alajouanine and La Grange believe that the papillary changes are caused by an intracranial, paroxysmal hypertension. This can be explained by a hypersecretion of the choroid plexus caused by the removal of cerebrospinal fluid or other modifications in the hydraulics of the fluid. This hypertension may impose an obstacle to the return circulation or it may produce symptoms of localized arterial hypertension.

Thus, the ocular complications of spinal anesthesia must be separated from those incident to the lumbar puncture. We have had the average experience, namely, 1 case of diplopia in 500 inductions, and all cleared up within two weeks.

The explanation usually given of the mechanism by which the sixth nerve becomes involved postulates an edema of the brain consequent to the injection. The long course of the sixth nerve at the base of the brain allows for relatively more stretching. This, it is believed interferes with its function. As the edema subsides, there is a recession of symptoms. If this explanation be valid, why does the diplopia frequently occur four, five or six days

after the injection? Why are there frequently no other symptoms of cerebral edema?

Another explanation advanced is that the sixth nerve is particularly susceptible to the effects of the anesthetic. While there is some evidence that different nerves are variously affected by anesthetics, why, again, the delayed activity? And why not a more uniform occurrence of this complication?

In the treatment of this condition, the element of time is the most important factor. Patients may be confidently assured of complete cure. Rest in the recumbent position is helpful.

Another complication is pain in the eyeballs on ocular movement. This is also best controlled by eye rest and depressants.

We have had a few cases of photophobia. These were associated with meningismus, and lasted no more than one week.

#### MENINGISMUS

The incidence of meningismus encountered by us is 1 in 600. It is usually ushered in on the day following the anesthesia induction with headache. Dizziness, stiffness of the neck, occasional inequality and sluggishness of the pupils, photophobia and eyeball pain follow. The symptoms are aggravated by raising the head and movement of the body.

The cerebrospinal fluid shows the picture of an aseptic meningitis. The symptoms last for two or three days and then subside spontaneously.

These patients are not relieved by coal-tar derivatives nor even by codeine. Magnesium sulphate by enemata or intravenously and spinal puncture are the only effective measures. They are used here as advocated above in the treatment of headache, the underlying principles being identical.

#### MENINGITIS

The occurrence of a true, purulent meningitis as a complication of intraspinal anesthesia is a rarity. Despite the warning

of certain authors that subarachnoid block is contraindicated in sepsis, numerous cases are on record wherein purulent meningitis did not result. Indeed, but 9 cases in all the hundreds of thousands of inductions over a period of over twenty years have been reported in the literature. Of these, only two resulted fatally. However, the data contained in the reports were so meager that it is possible that not all the cases cited had a true purulent meningitis.

During the first twenty-four to forty-eight hours after operation, the symptoms of headache, stiff neck, restlessness, ocular aberrations and increased temperature make their appearance. Shortly afterward the characteristic symptoms and signs of a purulent meningitis are in evidence. The spinal fluid is turbid, the globulin and cell findings are raised, and there is a variable degree of elevation in the pressure of the cerebrospinal fluid which contains organisms.

Cases of true purulent meningitis have been reported by Wertheimer,<sup>34</sup> Senge,<sup>35</sup> and Sanchis-Banus.<sup>36</sup> Boros<sup>37</sup> reported a case which he described as a case of cystic, purulent meningitis following lumbar anesthesia induced with novocaine. It was his only case in a series of 1439 induction over a period of eighteen years, during which he encountered 25 per cent of headaches. His patient was a twenty-five-year old man, operated upon for a right, incarcerated inguinal hernia. Twelve hours after operation, the patient complained of severe headache, became restless and lost consciousness. At the end of three hours all the cardinal symptoms of meningitis were noted. Boros administered 40 per cent urotropine solution intravenously. Upon lumbar puncture a sterile, turbid fluid under high pressure was obtained. He repeated his injection of urotropine and gave in addition 10 c.c. of trypaflavine intravenously. The symptoms gradually regressed and by the sixth day had ceased entirely. The novocaine was examined and found to be sterile. Boros quotes a similar case in the experience of Pautrier. Silva<sup>3</sup> adds 2 fatalities, occurring a few minutes

after the intraspinal injection, the spinal fluid being very turbid in one.

Meningitis has occurred after diagnostic lumbar puncture alone. Symonds<sup>38</sup> reported a case that recovered after the institution of irrigation of the subarachnoid space. Sonnenschein,<sup>39</sup> however, presented a case of meningitis following diagnostic lumbar puncture that terminated fatally.

It would seem, therefore, that meningitis following intraspinal anesthesia need not necessarily result from the use of contaminated anesthetic agents, or ensue in a patient suffering from septicemia consequent to the establishment in the meninges of a *locus minoris resistentiae* brought about by the trauma of the lumbar puncture needle.

We have operated upon at least 30 patients in whom there were positive blood cultures without the production of a meningitis. It is our belief that such cases do not offer a contraindication to the use of spinal anesthesia.

Five years ago, seven days after an appendectomy in a sixteen-year old girl, classical symptoms of meningitis developed. Examination of the cerebrospinal fluid revealed the meningococcus as the causative agent. The biological characteristics of this organism ruled out the likelihood of any but a coincidental relationship of the meningitis to the anesthesia. This case terminated fatally after three weeks.

In a recent unpublished report of 496 spinal anesthetics from a local institution there was 1 fatal case of meningitis due to a pyocyanus infection.

It must be remembered that suppuration at the puncture site is a definite contraindication to spinal anesthesia. Van Lier<sup>10</sup> reported a staphylococcus meningitis as a result of passing a needle into the subarachnoid space after traversing an unsuspected abscess in the sacrospinalis muscle. The cerebrospinal fluid was but slightly contaminated and the patient recovered.

The treatment of this complication needs no discussion here.

## INJURIES TO NERVES

Nerve injuries following spinal anesthesia are fortunately rare. Furthermore, they are usually transient in nature. Exceptionally, symptoms and signs may exist for many months and cause not only great discomfort and annoyance to the patient but also considerable chagrin to the surgeon.

Damage to the spinal cord or to the roots may result in anesthesia, paresthesias, trophoneurotic changes leading to atrophy of muscle groups, decubitus ulcers, sharp, lancinating pains along the course of nerves, and transient anal or vesical incontinence. If more severe damage has taken place, transient paresis may be replaced by permanent paralysis, although the latter is even more rare than the sequelae of the milder forms of nerve irritation or trauma. It is difficult to damage the nerve bundles even when they are held free in one's fingers and attempts to penetrate them with a needle under direct vision are made.

Ramenti<sup>11</sup> reports a fatal case in a man, aged sixty-five years, who was dismissed on the twelfth day after radical operation for hernia, and on the fourteenth day after leaving the hospital developed meningismus with paresis, paraplegia and other symptoms of cord disease, with disassociation of sensibility, septicemia, splenomegaly and jaundice. Death appeared seven weeks after the onset of the symptoms. Devraigne, Suzor and Laennec<sup>42</sup> described a most interesting experience. Cesarean section was performed upon a multiparous woman of twenty-six because of the presence of a placenta previa. Two c.c. of a 5 per cent novocaine solution were employed. Heaviness of the lower extremities appeared four days after operation. On the following day there was a complete flaccid paralysis of the lower extremities. The knee jerks and the tendo Achilles reflexes, and sensation were absent. The trunk muscles and upper extremities were equally paralyzed. The olecranon and radial reflexes were also abolished and paralysis extended as high as the muscles

of the neck where it was less marked. There was no paralysis of the eye, tongue or soft palate muscle; nor was there any vesical or anal incontinence. Headache was conspicuously absent. The condition was thought to be due to a more rapidly spreading poliomyelitis than that usually seen in the ordinary infectious variety. On the following day, very little paralysis was present, and on the day immediately after, the quadriplegia was almost all gone save for slight weakness of the muscles of the lower extremities. The patient was discharged as cured eighteen days after operation.

Out of a total of more than 1100 cases, Case<sup>43</sup> reports one nerve complication which occurred on the service of a colleague, J. M. Nielson. A perineal repair was done on a thirty-six-year old woman. As the anesthesia was beginning to wear off, the patient began to complain of severe pain in the tip of the coccyx and sacral region. This continued unabated for two weeks and was relieved temporarily by heat and not in any other way except by opiates. With the pain there appeared a saddle-shaped area of total anesthesia in the perineum and buttocks, and rectal and vesical insensibility, the patient losing control and becoming incontinent.

When seen two weeks after operation, the foregoing was confirmed; but there was in addition hyperesthesia in the first sacral and second sacral areas on the left and in all the lumbar segments on the right. The lumbar segments escaped on the left; while the first and second sacral segments escaped on the right. The pain was greatly increased by raising the trunk, straining coughing or sneezing. A diagnosis of cauda equinae lesion was made, probably hemorrhagic. Improvement had been steady but slow. At this writing, five weeks after the onset, there is marked sensitiveness in the area formerly totally anesthetic. The other segments have returned to function but the patient walks clumsily. The final healing in this case was complete and there is at present no complaint whatsoever, nor any objective sign of nerve disturbance.

Orth<sup>12</sup> reported no nerve complications in a series of 1400 lumbar anesthetics

and Warnecke<sup>22</sup> none in 1500 inductions. A case of paraplegia of the lower extremities as described by Lemoine<sup>44</sup> is of interest. No anesthesia resulting after the apparently subarachnoid injection of 12 cc. of allocaine for a varicocele operation, he resorted to a local novocaine infiltration. On the same evening, there appeared a paraplegia of both lower extremities, with the sensation of pins and needles in the feet. Micturition was normal. The planter and abdominal reflexes were intact but the knee jerks were absent. On the seventh day after operation anesthesia of the legs was no longer present and motility was almost normal. Lumbar puncture on the second day after operation had elicited a clear spinal fluid with no signs of meningeal irritation.

Bazy<sup>18</sup> operated upon a fifty-nine-year old man for hernia. Soon after operation, the patient complained of pain in the limbs similar to cramps and weariness. Complete loss of sensation in the entire gluteal and genital regions followed. The gluteal muscles, especially, were hard on palpation; nor was their elasticity hardly restored after three years. Increased knee jerks were likewise present.

In a small series, no more than 100, under novocaine anesthesia, Izquierdo<sup>13</sup> noted 1 instance of paralysis of the lower limbs that lasted for an entire month, 1 case of anal incontinence of a week's duration, and 1 case of marked necrosis. None of these cases were described in detail. Decubitus ulcers have been reported by Bilancioni,<sup>45</sup> Fischer,<sup>46</sup> Klein,<sup>47</sup> and Sudeck.<sup>48</sup> Nonne and Demme<sup>49</sup> encountered a case of degenerative myelitis in a man of fifty-nine, operated upon under tutocaine anesthesia, who later expired. Three instances of paralysis of the external popliteal and sciatic nerves were noted in a series of 2207 rachianesthetics by Cotte.<sup>50</sup> Babcock's experience<sup>51</sup> is particularly interesting. On 11 different occasions, spinal anesthesia was induced in one of his patients without any evidence of nerve injury. In 1 case, however, he produced a marked radiculitis by the

accidental injection of a nerve root. Lee<sup>52</sup> who has seen no cases of injury to the spinal cord states that Weigelt<sup>53</sup> adds two additional cases to two that he had previously reported. Paraparesis occurred in a woman fourteen weeks after spinal anesthesia. This was eventually followed by complete recovery. In the other patient the paralysis followed the intraspinal anesthesia twenty-seven months after its injection, with a fatal ending. Autopsy showed obliteration of the subarachnoid space in the thoracic and lumbar regions. The obliteration was caused by chronic inflammation and fibroid thickening of the meninges. Secondary changes in the spinal cord were due to deficient blood circulation, and to compression. It seems to us that one should be careful before ascribing such a result occurring so long after to the subarachnoid injection.

Organic changes rarely come on in after-life following a previous spinal anesthesia. Occasionally, patients have resorted to the law in an effort to collect compensation on such a basis. According to Evans<sup>5</sup> only 2 cases appear in the literature where, after careful neurological examination, such a claim, following lumbar puncture, might be justifiable.

Direct injury to the cord may be occasioned by high injections. In the 496 cases cited under meningitis reported from a local hospital there was one fatal paraplegia following an intraspinal anesthetic administered between the eleventh and twelfth dorsal vertebrae. It is, therefore, of interest to recall that Jonesco<sup>54</sup> the foremost exponent of high injections, puncture being practiced at a level as high as the cervical region, has experienced no serious sequelae and no complications in 6200 rachianesthesias.

Three years ago, we did a tracheloplasty, perineorrhaphy, Simpson-Gilliam ventral suspension of the uterus and appendectomy on a twenty-six year old patient. Eight days postoperatively, she developed a weakness in her left quadriceps femoris group which became progressively worse so that, two weeks after operation, she

could not raise her leg off the bed. She could not walk for three months. Finally, power was slowly restored to the muscles and at the end of a year, her thigh was as strong as before the operation. In our opinion this complication was due to a nerve root injury occasioned during the spinal tap, despite contrary opinion advanced by consultants, who believed the condition to be due to unexplained trophic disturbance.

We have had 2 other cases of weakness of the quadriceps group lasting only four to five days.

There have been occasional cases of tingling of the lower extremities, anesthesia of the buttocks, itching about the anus, all lasting less than three days. None of these complications presented any serious aspects.

#### PSYCHIC DISTURBANCES

Much has been written concerning the psychological aspect of spinal anesthesia. Indeed, some authors object to any form of anesthesia, not excluding spinal, which allows the patient to retain consciousness during the operative procedure. This does not apply, of course, to some minor condition for which the public has been taught to expect local infiltration.

Lee<sup>55</sup> in discussing Schultz' report of 2251 cases from the Lankenau Clinic refers to his experience in the Department of Mental and Nervous Diseases, of the Pennsylvania Hospital, where the mental chaos of certain types arising during an operation under some form of local anesthesia has been followed by various grades of mental catastrophe.

Izquierdo<sup>13</sup> mentions 1 case of insanity that cleared up completely after a month's duration. A case of postoperative psychosis was reported by Bianchi<sup>56</sup> that occurred in a young man who had been a hard drinker. Following a herniotomy, an acute psychosis with hallucinations set in and lasted for two weeks. Such a sequel to operation, however, has been encountered under other forms of anesthesia among patients long addicted to the use (or, rather, abuse) of alcohol.

Our experience has revealed very few instances of psychic aberrations following spinal anesthesia. One case stands out clearly in our memory, to wit, a young man, thirty-two years of age, operated upon for a floating kidney. He had been markedly apprehensive over his condition for months before submitting finally to surgical intervention. Having discussed spinal anesthesia with several of his friends who had been operated upon by this method, he did not approach the event with any undue fear. While he was in the hospital, complete collapse of his left lung appeared but cleared up entirely before discharge. Shortly afterwards, he began to complain of a sensation of water running down along his right side, the site of the nephropexy, from the upper margin of the wound down along the right lower quadrant of the abdomen and along the anterior and inner aspects of the right thigh. A thorough physical examination which included several complete genitourinary and neurological investigations failed to reveal any organic cause for the paresthesias of which he complained. At the present date, approximately six months after operation, he still feels these sensations at frequent intervals and has become a well developed hypochondriac, indeed, to such an extent, that he is unable to maintain a steady rate of employment. Lately, we occasionally encounter a psychosis after spinal anesthesia; but only in neurotic or apprehensive patients who have received sodium amytal intravenously previous to operation and in whom the psychosis is directly referable to the sodium amytal. At times, delirium, hallucinations and an acute maniacal state result, to disappear completely within a few days. From straight spinal anesthesia, however, with the exception of the case cited here, we have had no psychic disturbances.

Another possible complication is that resulting from the application of heat to the lower extremities after the patient is returned to bed and before the anesthesia disappears. In one of our cases a

hot water bag so applied produced a serious burn of the plantar surface of the foot.

Occasional instances of coma (Coulin)<sup>52</sup> and of recurrent syncopal attacks (Izquierdo)<sup>13</sup> have been reported in the literature.

Pulmonary complications following spinal anesthesia are certainly less frequently encountered than after inhalation narcosis. From January 27, 1929 to September 23, 1929 we operated on 1819 patients. Of these 1010 were done under spinal anesthesia. The remainder belonged to the type of minor operation in which it was not deemed worth while to enter the subarachnoid space, to wit, incision of subcutaneous abscess, excision of sebaceous cysts and superficial lipomata, and the like.

In these 1010 cases which incidentally remained in the hospital ten days or more, there developed 3 cases of pneumonia, 11 of bronchitis, 4 of dry pleurisy, and 1 massive collapse of the lung. There were no fatalities. These cases were collected during the summer and winter months and represent a fair average of weather conditions. Compared with the report of Cutler and Hunt<sup>58</sup> in which 55 pulmonary complications with 11 deaths were noted in 1562 operations under inhalation anesthesia, spinal anesthesia seems preferable.

If there be anything in the hypothesis that inhalation anesthesia by its irritating effect on the tracheobronchial mucosa predisposes to pulmonary infection, block anesthesia is certainly indicated in order to lessen lung complications.

In reviewing the postoperative experience of a large number of patients operated on under this form of anesthesia one is struck by the comparatively slight amount of nursing care necessary to keep them comfortable. From this standpoint alone, one receives the decided impression that spinal anesthesia is followed by fewer annoying sequelae. On the whole, the relative values of spinal and inhalation anesthesia can be gauged only by clinical impressions gleaned from a comparison of an extensive series of cases. Our opinion needs no further expression.

[NOTE: For references see authors' reprints.]

# PERITONITIS FOLLOWING ABDOMINAL SURGERY\*

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POSTOPERATIVE peritonitis is a contingency that should not be allowed to occur, but like many things that ought not to be, it will occasionally happen. It is only natural that we ask ourselves, Why? Following abdominal surgery peritonitis may result from infection present before the operation or it may be due to the operation itself; in other words, either an external or an internal factor or both factors may be responsible for this undesirable postoperative event.

Let us first consider the external factors. These may be summed up in the words aseptic technic or rather the lack of it. As we all know, the instruments and the hands of the operating staff may be the source of bacteria and the agency of their dissemination. These factors are avoidable by careful technic. It goes without saying that all instruments, gauze, ligatures, etc., should be aseptically prepared and should be kept sterile. In the Lankenau Clinic we have a detective in the person of the bacteriologist who at any time and as often as he wishes takes smears and cultures of the hands of the operating personnel from the surgeon down. In fact there is a pleasant rivalry among us as to the best record for this personal asepsis.

The second external factor is the skin of the abdomen of the patient. Staphylococcus we know is always present in the skin and is not an infrequent finding in postoperative peritonitis. Therefore an essential part of operative asepsis is careful preparation of the patient. These are mechanical factors. They are controllable and should never be the cause of postoperative peritonitis. But not all external factors are mechanical and controllable: for example, penetrating wounds of the abdomen. While proper technic, as a rule, provides against this type of infection, it cannot always be controlled since much depends upon

the conditions prevalent at the time of the injury. But naturally every effort must be made to get as aseptic an operative field as circumstances permit.

Now as to the intra-abdominal factors, or infection present at the operation. This comprises the main point of our discussion. As a rule the infection resides in the operative field and its vicinity. It may however reside in a distant focus. The defensive mechanism of the body may be so weakened by disease that organisms from a distant focus may be released by the operative act and find a fertile soil in the peritoneum. The lesson carried by this possibility is preoperative attention to oral hygiene, the respiratory tract, etc., in fact all precautions that make for safe surgery. The local intra-abdominal sources for possible dissemination are numerous and varied. I need but mention two of the more common ones: encysted collections of pus from an inflamed appendix or from a pelvic abscess. The prevention of peritonitis in these cases is both a matter of diagnosis and of operative technic. Preoperative determination of the presence of an abscessed appendix should lead the surgeon to take the first step in preventing contamination by making the proper approach, an extraperitoneal approach when this is possible. In fact in all recognized infected cases the incision should be so planned as to enable the surgeon to deal with the infected focus without invading healthy tissue. This means also the proper placing of gauze pads, using sheets of rubber dam, providing proper drainage, etc. There are, of course, no rules for these procedures. Their use is a part of surgical judgment and their efficiency is established by the high or low incidence of postoperative peritonitis in the records of each individual surgeon.

An encysted collection of pus in the

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majority of cases of appendicitis fortunately is in the lower right abdomen, and can be evacuated by an extraperitoneal approach; where the collection is high up, lateral and posterior to the base of the cecum and colon, the extraperitoneal incision, carried well out and dividing the muscles in the line of the skin is also less likely to be followed by postoperative peritonitis than when the incision is made over the most prominent part of, or mesial to the swelling. After the abscess cavity has been evacuated and no rivulets of pus are seen emptying into the cavity, and the appendix is neither visible nor palpable, nothing more than drainage of the cavity should be done. It is our practice to pack the cavity lightly with loose gauze wrung out of a 1:20 carbolic acid solution. When the appendix can be seen and felt and can be removed in its entirety without danger of breaking through the limiting wall that separates it from the preperitoneal cavity, it is removed and the cavity packed with loose gauze. When the limiting wall is broken through and especially if there is a small amount of pus at the base of the appendix, the cavity is packed at once, and after separating the parietal from the visceral layer of peritoneum around the inner circumference of the cavity, we lift up the abdominal walls and the underlying parietal peritoneum, introduce a large sheet of rubber dam and follow this by the introduction of one or more large abdominal pads and smaller pads, if necessary, to wall off and thoroughly protect the surrounding peritoneum. The appendix is then removed and the cavity packed. This is frequently done in our clinic with good results, which means no postoperative peritonitis, and as a rule recovery. Where the walls of the encysted collection are made up entirely of coils of small intestine, the risk of subsequent peritonitis is greater. If we are able to recognize the condition we hesitate to do an early operation.

In case of a pelvic encysted collection, if it is low down the incision is made, in the

male through the rectum, and in the female through the roof of the vagina, posterior to the cervix. If the pelvic collection is located in the median line the incision is made above the pubis after the bladder has been emptied by catheter. In a pelvic abscess resulting from disease of the uterine appendages, the approach is best made through the vagina. But if there is any uncertainty about the state of affairs, that is, if there is danger of puncturing a coil of bowel, we open the abdomen in order to ascertain the topography and then make the approach through the vagina and close the abdominal wound.

A potential cause of postoperative peritonitis is found in operations on the intestinal tract in which the gut, with its rich bacterial content, has to be incised. Here also the careful planning of the operation and meticulous care to avoid contamination by spilling the intestinal contents will prevent the undesirable postoperative complication we are discussing. In operating an intestinal obstruction when one is not absolutely sure that the obstruction has been relieved there should be no hesitancy in turning out the entire small intestine so that it and the large intestine can be thoroughly examined. No harm need accrue from the procedure provided the operative field is sterile and the intestines are well covered with large warm gauze pads.

The foregoing are some of the more common causes of peritonitis after abdominal surgery. They can be recognized before or at the operation and with judgment and technic can, to a large extent, be so handled as to provide for an aseptic recovery. There are, however, a few potentialities which cannot be foreseen. Fortunately, they are rare. Among these may be mentioned an infected blood clot as in a ruptured extra-uterine pregnancy. In these cases it is always our practice to cleanse the peritoneal cavity of blood clots. Failing to do this runs the risk of the clot or clots becoming infected by migration of microorganisms through the walls of



the intestine. This applies likewise to intraperitoneal hemorrhage from any cause. Other cases may be attributable to overlooked intestinal obstruction due to incomplete primary operation for obstruction. For example, snaring of a knuckle of bowel into a rent in the mesentery, or into a congenital hole, or a loop of bowel that has become engaged between the margins of the opening in the transverse mesocolon through which the stomach is drawn in making a posterior gastroenterostomy and where the lesser peritoneal cavity has not been completely closed, when stitching the margins of the opening in the transverse mesocolon to the wall of the stomach immediately above the anastomosis.

Bile leakage after gall tract surgery causing a bile peritonitis also occasionally occurs and sometimes can be traced to unrecognized anomalies of the bile ducts; or to slipping of the ligature in the cystic duct, or to incomplete closure of the gall bladder bed after cholecystectomy. These are favorable cases for re-operation if not allowed to linger too long.

With these briefly stated facts in mind, it is easy to recognize that abdominal surgery has its pitfalls, which in most instances, however, can be avoided. It is a trite saying that the best way to treat postoperative peritonitis is to prevent it.

As already indicated the most important step in the technic of abdominal surgery where infection is present is to avoid contaminating the peritoneum around the infected area. This is the surgeon's greatest concern. What is the best way to guard against spreading infection? First, its recognition by inspection, color and odor; secondly, by taking smears of the area around and distal to the operative field, having them examined and immediately reported upon. This takes but a few

minutes, provided the proper equipment is at hand, which includes above all a competent bacteriologist working in a room adjoining the operating theater. This is one of the operating surgeon's greatest assets. I realize that this equipment is not always at hand, but that fact does not alter the desirability of having it. The report of smears of the area distal to the site of infection is a guide as to how far to carry protection, as well as to the amount and kind of drainage to use and where it is to be placed so as best to serve its purpose.

If in the absence of these precautions or in spite of them, peritonitis does set in, the treatment is the same as for the preoperative inflammation, that is, providing for localization by the usual measures of complete anatomic and physiologic rest and re-operating at the most opportune time. While some surgeons advocate immediate re-operation, this is not our practice, except where the operation has been done for a visceral injury. If, as sometimes happens, the patient on the first or second day appears not to be doing well, prompt re-operation is indicated. By not doing well, we mean, of course, presenting the usual signs and symptoms of peritonitis, rigidity, hyperperistalsis, tenderness, etc. With the patient under the careful constant observation of a well-trained interne, the time for operation can be better seized than in the preoperative case when peritonitis has, as a rule, already set in when the patient is brought to the hospital. While the postoperative case has this advantage, it labors under the great disadvantage of the effects of the first operation and it is only by superhuman efforts and good fortune that recovery takes place. Therefore the trite dictum cannot be too often repeated: The best way to treat postoperative peritonitis is to prevent it.



# CONCEALED HEMORRHAGE FOLLOWING OPERATION

## DIAGNOSIS AND TREATMENT\*

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**H**EMORRHAGE following laparotomy is fortunately an infrequent complication. The precision of technical procedures and more accurate diagnosis have lessened the possibilities of post-operative hemorrhage. It is, however, still a complication of magnitude and one that should be considered after some types of abdominal surgery. There are certain complications which occasionally follow any kind of laparotomy: shock, gastric dilatation, hemorrhage, cardiac failure and embolism. These are directly due to anatomical causes and when they occur within the first twenty-four hours after operation are sudden and tragic. During the second twenty-four hours, concealed hemorrhage may well be a possible complication and still later hemorrhage may occur as a secondary development of abdominal sepsis. True shock is, however, rare. At the present time the infrequency of shock is due largely to the preparation of the patient by means of a dry technic rather than by the prolonged washing and scrubbing of former days when the patient frequently lay in a pool of wash water and suffered varying degrees of bodily refrigeration.

Bleeding into the abdomen after operation, where the abdominal wound has been sutured without drainage, is almost invariably associated with intense abdominal pain. The escape of blood into the peritoneal cavity induces very definite clinical signs of chemical peritonitis. There is more than the accustomed postoperative rigidity, the abdomen is fixed and the patient can accurately localize the area of pain because it is due to the escape of fluid into a localized portion of the abdominal cavity.

After certain types of operation, particu-

larly where gauze drainage has been employed, such as the tamponage of the bed of the board ligament after removal of an intraligamentous cyst or from the parenchymatous oozing that comes with the evisceration of an inflammatory mass, there is the rapid loss of body fluid as the result of serum drainage and the clinical condition resulting therefrom is very apt to simulate hemorrhage. The patient is somewhat pallid, the pulse is rapid and in a cursory way the clinical picture does suggest the general appearance of the patient who is suffering from intra-abdominal hemorrhage. This condition, however, should not be confused with hemorrhage. The patient has a tachycardia from loss of body fluids, but there is no change in the blood color or in the red cell count. Furthermore if the gauze drainage is pinched between the thumb and first finger there will be a moist impression with no cobweb-like fibrillae of fibrin formation. If there is a real loss of blood upon pinching the gauze between the fingers there will remain upon them cobweb-like fibrillae of fibrin and blood.

Hemorrhage as a postoperative complication may be roughly divided into two great groups: (1) cases in which hemorrhage may be occasionally expected or anticipated, and (2) cases in which hemorrhage is not to be expected or anticipated. Surgical intervention in the right upper quadrant in which the pancreas may be infected or injured are operations that contribute par excellence to the liability of hemorrhage. There is an increased tendency for hemorrhage in any disturbance of the pancreas on account of the unusual blood supply but more particularly from the escaped pancreatic juice with its

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marked lytic properties causing erosion of adjacent or contiguous blood vessels. Whenever jaundice is present there is always the possibility of concealed hemorrhage. It is noteworthy that after operations on the common duct there is a distinct tendency for this complication to occur. The effect of jaundice is essentially chemical, not infectious, and hemorrhage is one of its most frequent manifestations. It is interesting to note that in approximately 75 per cent of the cases that die after operations on the common duct there is found at autopsy an intra-abdominal collection of fluid blood varying from 300 to 800 c.c. and in fully half the cases where death takes place postoperative hemorrhage is an important factor in the production of death.

There is also an increased element of intra-abdominal hemorrhage after hysterectomy, after enucleation of tumors from the bed of the broad ligament. The hemorrhage that sometimes ensues after hysterectomy is usually rapid, characterized by very great escape of blood and the clinical signs of hemorrhage are dramatic and rapid. In the hemorrhage that occurs from oozing from the bed on the broad ligament or after enucleation of inflammatory masses, there is apt to be capillary bleeding from many bleeding points which individually are negligible but which collectively represent a great loss of blood. This type of bleeding occurs from raw areas of intestines, or where large portions of the peritoneum have been denuded as in the separation of inflammatory or postoperative adhesions. Let it be remembered that the omentum contains no muscle tissue and every bleeding point on the omentum is apt to continue to bleed unless it becomes adherent or agglutinated to adjacent peritoneal surfaces or ligated.

The diagnosis of concealed hemorrhage rests upon the ascending pulse rate. In all laparotomies where there is the possible chance of hemorrhage being a factor, such as gastroenterostomy, resection, hysterectomy, enucleation of intraligamentous cyst,

anastomotic operations on the bowels, operation in the presence of acute inflammatory tissue, a very excellent precaution is to take half-hourly pulse determinations and have them charted; an acceleration of the pulse rate from half hour to half hour, over a period of time, is especially significant. A successive fall in the red blood count and in the hemoglobin are of value when hemorrhage is suspected but it will seldom be carried out as a routine postoperative measure.

After almost all clean cases of abdominal surgery there is a rise of temperature for the first twenty-four to thirty-six hours. This is a natural reaction, representing the so-called surgical, traumatic or operative fever. There is a definite parallellism in the relationship between temperature, pulse and respiration. Theoretically, for each degree of fever one can expect an increase in the pulse rate by ten, an increase in the respiratory rate by two, and this parallellism is ordinarily preserved. If hemorrhage in any great degree has taken place there is a loss of this definite parallellism and the pulse rate is increased out of all proportion to the temperature.

The symptoms of concealed hemorrhage will largely depend upon the rapidity of blood loss. If the blood loss is continuous but slight the transition from a condition of comparative well-being to that showing a typical picture of hemorrhage will be by such easy stages as to deceive the observer unless he has in mind the possibility of bleeding. Of outstanding importance is the gradual continuous and progressive increase in the frequency of the pulse. The pulse in hemorrhage is quick, shows less volume and there is a peculiar snap as each pulse beat impinges upon the examining finger. The respirations are invariably shallow and frequent, with a suggestion of air hunger, although I have seldom seen marked air hunger. The skin is moist, owing to a lack of vessel tone. There is a distinct change in the color of the patient. The patient is not only pallid but there is a pearly-like tint to the sclera, the facies has

an expression of acuteness and alertness: there are purposeless movements of the arms and legs but as a rule not of the body. The patient subconsciously restrains body movement in the desire to obtain the greatest amplitude of inspiratory respiration. There is a distinct loss of surface heat and the patient complains of an inexpressible sense of weakness.

The first and most outstanding question to be answered: is the hemorrhage continuing or is it stopped? Are we dealing with a single massive hemorrhage, dangerous to be sure, but arrested, or are we having a continuous and continuing hemorrhage? The type of operation and the pathology exposed at the operation very often will help in the consideration of this question. The bleeding from a gastroenterostomy is apt to be interrupted and repetitive, while bleeding from a single large vessel, such as the broad ligament, is apt to be continuous and a lethal termination occur within a relatively short time.

The essential element in the treatment of any hemorrhage is to stop the bleeding and the best time and place to stop bleeding is at the time of the operation. No patient should be returned to bed while the possibility of hemorrhage is still present. The question whether transfusion should be employed and when, is a question requiring nicety of judgment. To give a patient who has been almost bled white a transfusion is oftentimes the cause of fresh bleeding, with a sudden collapse and death. If the patient suspected of having concealed hemorrhage and in whom the diagnosis is reasonably sure has a pulse that is well maintained although rapid, it is many times wiser to watch the patient and allow the bleeding to be more fully arrested than to give an immediate transfusion. At the end of eight to ten hours give a small transfusion and two days later make up for the blood loss by a larger transfusion.

The loss of blood into the abdominal cavity represents not only a loss of the cellular elements of the blood but a great loss in the fluid volume and since the heart

requires a certain periphery resistance to maintain circulation fluid should be administered to the patient by practically all avenues, skin, mouth, vein or rectum, unless there are local reasons against the employment of one or the other. In surgery in the upper abdomen, or of the lower abdomen not involving the colon, proctoclysis of tap water with 10 per cent glucose should be instituted. If the operation has been pelvic, water by mouth in the absence of vomiting should be given and hypodermoclysis in all cases. The intravenous introduction of normal saline is associated with some of the dangers outlined here for transfusion, but not all. If however, the patient is in extremis from actual blood loss transfusion must be done immediately as there is a point beyond which patients cannot bleed without dying and the risk of activating the hemorrhage from transfusion must be accepted in order to keep the patient alive and to allow reopening of the abdomen for hemostasis.

If the surgery has been in the nature of gastric resection or a gastroenterostomy the bleeding will be into the stomach and the patient will vomit a greater or lesser quantity of blood sometime after operation. When surgery has been performed on the large bowel the presence of blood in the bowel lumen below the point of anastomosis will invariably stimulate bowel peristalsis with the evacuation of a fluid stool or a soft stool of fresh blood or partially oxidized dark blood. The bleeding that occurs into the stomach after a gastroenterostomy or resection very soon establishes a vicious circle. The more bleeding that occurs the greater the distention of the stomach and the greater the distention the more apt is bleeding to continue. The introduction of a stomach tube through the mouth or a Levine tube through the nose and the evacuation of all of the blood from the stomach is one of the best means of stopping gastric hemorrhage for it allows the stomach to contract and by contraction lessens the liability of further bleeding. We have practically never seen

harm result from a carefully introduced stomach tube, even as recently as two hours after a gastric operation, provided the stomach contents are aspirated and not removed by lavage.

The elevation of the foot of the bed has a decidedly beneficial effect in keeping the diminished blood volume in circulation and by providing more adequate blood supply to the already anemic brain centers. Morphine in sufficient doses to quiet the patient and render the patient less acute is indicated. The application of external heat is highly desirable but great care must be exercised in the prevention of burns. The normal patient may tolerate a hot water bottle applied to the body with impunity but which if applied to a patient suffering from hemorrhage a lesser degree of heat is sufficient to produce extensive burns.

The decision to reoperate a patient suffering from concealed hemorrhage is always a difficult one; the natural hope of most surgeons is that the bleeding has stopped and if arrested nursing and adequate postoperative care will safeguard the patient. There is a time, however, when difficult as the decision is it must be made, as failure to reoperate for concealed hemorrhage before it is too late is tantamount to robbing the patient of any expectation of being saved.

At the present time postoperative concealed hemorrhage is fortunately so infrequent that this decision comes but rarely even in an extensive surgical practice, but it does occur and it is our observation that the decision to reoperate is many times too long delayed. If the decision to reoperate is made an immediate transfusion should be given and the moment the transfusion is terminated, the wound should be reopened and the field of the previous operative procedures carefully canvassed. The technical procedure of operating in a

field infiltrated with blood, and one that a short time before has been operated upon, is no easy matter. Here again the type of surgery suggests the most probable cause of the bleeding: bleeding after cholecystectomy is obviously either from an incompletely ligated or a loosened suture on the cystic artery, for bleeding from the bed of the gall bladder is ordinarily not of sufficient magnitude to require reoperation. Packing around an untied cystic artery is not apt to be successful as the control of hemorrhage from this vessel always requires ligation. If a gastroenterostomy suture line is suspected of bleeding, or the site of anastomosis between stomach and intestine, an anterior gastrotomy with partial evisceration of the inside of the stomach is the easiest and quickest way to apply direct ligation to the bleeding point and is satisfactory, while the taking down of an anastomosis will seldom reveal the actual bleeding point and will require every detail of the original operation to be reenacted.

Bleeding from soft tissue beds, paranchymatous bleeding or hemorrhage from separated adhesions, requires packing. The operative field is carefully quarantined by placing sheets of sterile rubber tissue about the area and into this barricade, so to speak, sufficient sterile gauze is introduced to maintain adequate pressure for hemostasis.

After reoperation for hemorrhage all of the measures of combating shock and blood loss should be carried out. As long as the pulse is regular, although very fast, the surgical policy should be: rest, fluid replacement and no stimulation. There is a period of a few hours after operation when a wise and masterly inactivity, with a therapeutic courage to just maintain the patient, is far better than unwise measures aimed at stimulating the patient.



# PREVENTION OF ABDOMINAL ADHESIONS\*

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THE prevention of postoperative adhesions depends entirely on the prevention of inflammatory reaction and in cases in which denuded surfaces are produced by the operative procedures, or in which preexisting adhesions are separated during operation, on the peritonealization of all such surfaces. If, in spite of every care, postoperative adhesions seem to be inevitable, then every effort should be made to adjust the intestines in such a way that these adhesions will not result in ileus.

Anything which bruises, abrades or irritates peritoneal surfaces predisposes to sufficient inflammatory reaction to produce adhesions. All rough handling, therefore, the catching of peritoneal surfaces with tissue forceps or clamps, or the use of irritating antiseptics like tincture of iodine, should be avoided. Dry sponges and wipes readily produce such injury and for that reason should never be used in the peritoneal cavity, but only warm moist sponges. Moist sponges are also greatly superior to dry in absorbing blood and other fluids; the advantage of such moisture was emphasized by earlier writers who spoke of such sponges as greedy; but this advantage has been largely lost sight of by modern operators. Moistening the wipes and sponges with normal salt solution instead of ordinary sterile water may perhaps render them less irritating, but that has not been demonstrated and the difference could certainly be but slight. (Some ambitious student or interne might perhaps make a study of this by animal experimentation and thus produce an interesting thesis.)

Any foreign matter in contact with peritoneal surfaces, like a cigarette drain or rubber tube, necessarily produces a degree of trauma which predisposes to

adhesions, and if left long in contact will infallibly produce them; hence when it is at all possible such drainage should be protected by being placed in contact with some fixed portion of the bowel, as the colon, or by the judicious interposition of the omentum, supported as necessary by a few stitches. This applies particularly to drainage of the gall bladder stump, which can be secured by pulling up the omentum and tucking it in between the liver and the transverse colon, fixing it in place by a few catgut sutures.

Drainage in an appendix operation is frequently necessary, but should almost invariably be secured through a stab opening far over to the right, and with the drainage itself so adjusted if possible, *by the fingers still on the inside of the abdomen*, that the omentum and cecum are utilized to prevent contact with the small intestines. The main incision can then usually be closed completely.

If on opening the abdomen preexisting adhesions are found, these should not be separated unnecessarily if they are so placed and of such a character as to offer no obstruction to peristalsis. Only such adhesions should be separated as are necessary in order to remove the pathology for which the operation is instituted. After the operation is completed every effort should be made to cover over all raw surfaces. This can frequently be done, if necessary, by rolling the affected loop of bowel upon its axis so that the raw surface is brought into contact with its own mesentery. A few stitches can then be inserted to hold it in position and thus there will be no raw surfaces exposed. Sometimes adjacent loops of bowel, each with a raw surface, can be adjusted to each other so as to safely bring the raw surfaces in contact, but care must be

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exercised that there is no space left underneath this union for the entrance of a free loop of bowel which would thus be liable to strangulation. The possibility of using the omentum in all these maneuvers should not be lost sight of, since it seems to have been developed for just such emergencies. Sutures should be of very fine silk or of fine plain or chromicized catgut, and should be inserted with great care and with the avoidance of all unnecessary exposure. It is of prime importance to avoid all tension.

The greatest liability to adhesions, however, occurs in the pelvis after operations for old inflammatory troubles which have resulted in extensive adhesions the separation of which may leave the entire surface of the true pelvis denuded. If nothing is done to protect this the omentum and small bowels will drop in and will inevitably form adhesions with resulting liability to postoperative ileus or other serious complication. This raw surface can always be completely peritonealized by making a free opening into the vault of the vagina at the completion of the operation, or leaving the upper end of the vagina open if the womb has been removed, and passing into the vagina the ends of two or three strips, according to the needs of the case, of washed iodoform gauze, the rest of the

strips being lightly placed in the pelvis as a fluff. The sigmoid is then swung around over this fluff and attached by continuous suture to the edge of the peritoneum at the brim of the pelvis. Good judgment should be used in bringing this around to see that there are no angulations produced as the stitches are inserted. In very rare cases the sigmoid is not quite sufficient, and then the space on the right can be filled by mobilization of the cecum. The omentum is then smoothly placed over the mobilized bowel and the incision closed. The gauze fluff should be removed after the lapse of one week, by catching the ends of the strips in the vagina. By that time their removal is almost or quite painless and if the opening has been made of proper size, there is no need of any replacement of the gauze. Vaginal douches should be used after removal of the fluff as needed for cleanliness. The sigmoid soon sinks down into the pelvis and thus makes a complete floor. There has been no raw surface exposed at any time.

Great care should be exercised in closing the abdominal incision to see that the edges of the peritoneum do not come in contact with the underlying intestines or omentum. The peritoneum should be closed by a running catgut stitch, with the edges carefully turned out so that such contact can be absolutely avoided.



# POSTOPERATIVE INTESTINAL OBSTRUCTION\*

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THE causes of intestinal obstruction in the non-operated abdomen are few. It is true that malignancies (principally carcinomas) of the intestine are apt to occur toward late middle life and early senescence, and that congenital anomalies, volvulus and intussusception must be considered in the diagnosis of intestinal obstruction in early life. During the major part of adult life, however, obstruction of the intestine is a rare occurrence except in these persons who have been subjected to an abdominal operation. Before the days of abdominal surgery, strangulated herniae occupied a similar position of importance as a cause of intestinal obstruction in adult life. In backward communities, where reducible herniae are neglected, operations for strangulated herniae are very frequent. Mission surgeons returning from Africa report a surprisingly high incidence of herniae among the natives, most of which sooner or later become strangulated.

In 88 cases of the authors, of intestinal obstruction during the last few years, in which operation was necessary, 32 cases had had some surgical interference in the abdomen. In this paper, however, the occurrence of intestinal obstruction will be considered as a postoperative complication, and only those cases discussed where the obstruction occurred during the patient's stay in the hospital, or happening a very short time after the patient's discharge from the hospital.

The cause of intestinal obstruction (postoperative) is the formation of adhesions either in the form of "fiddle-strings," broad bands, or the plastering together of loops of intestine with angulations or twists. The final cause of adhesions is obscure and their prevention even more elusive. No one has been able to explain why one simple clean case should be

followed by adhesions that obstruct, and another case where extensive manipulations are necessary remain free from symptoms. The plea of "gentleness in handling tissues" should always be made, but it is by no means the whole story. Case II came to operation with a three liter multilocular ovarian cyst. With the patient in the Trendelenburg position a low, midline incision was made, and the cyst found immediately below. A trochar was inserted and enough fluid withdrawn to allow the cyst to be delivered from the abdomen. There were no adhesions between the cyst and adjacent organs. The intestines, from the patient's position, were well up in the abdomen and no packing or handling was required. The cyst pedicle was clamped, ligated, sutured, peritonealized without the slightest difficulty, leaving a single small suture line, but to this later became attached the sigmoid colon so firmly in five days that obstruction developed which required surgical relief. It is difficult to imagine an operation on the abdomen where there was less tissue manipulation, and yet how many more serious cases escape this complication.

Another interesting, but most distressing group is the so-called plastic peritonitis case. Here extensive adhesions form between adjacent loops of intestines along varying areas of their contiguous surfaces. This condition is clearly beyond the control of the surgeon, but yet he is faced with the burden of repeated operations. One such case has been operated on four times. In another such case the filmy, sticky adhesions could actually be seen to form on the operating table. This patient developed a second obstruction within a few months, which required operative relief. No chemical or other treatment of value has been found to treat this condition.

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Considered as a postoperative complication it is first necessary to differentiate intestinal obstruction from paralytic ileus. Both conditions are apt to be associated with abdominal distention, tympany and vomiting. An absolute distinction cannot be made because paralytic ileus implies a functional obstruction. But distinction must be made between cases that are to be treated as outlined below for (a) ileus and (b) intestinal obstruction.

As a general rule the later onset of ileus can be predicted at the time of operation. Where abdominal infections have been stirred up, or where there has been undue handling of abdominal organs or intestines, one may confidently expect (and is seldom disappointed) paralysis of the intestine which lasts a varying period of time. Clinically, the patient shows increasing abdominal distention commencing twelve to twenty-four hours after the operation. The abdomen becomes tympanitic and tense. The abdominal muscles feel rigid, but this apparent rigidity is really due to the intra-abdominal pressure. No visible peristaltic waves are seen, and with the stethoscope no borborygmus is heard. Auscultation of the abdomen with the stethoscope is an extremely important part of an examination but is frequently omitted. As the distention increases the patient becomes dyspneic from interference with the movement of the diaphragm. The patient becomes cyanotic from cardiac embarrassment. There is usually a cold, clammy perspiration and the patient has an expression of anxiety and apprehension which may well be reflected in the faces of his attendants. In a short period of time emesis of a small quantity of dark fluid may occur. This is usually the indication for the passage of a stomach tube, which reveals the fact that a large amount of dark, foul-smelling intestinal contents distend the stomach.

It has been noted frequently by the senior author that in these cases the general appearance of the patient (aside from the abdominal findings) bears a

close resemblance to that of toxemia from infections of various anaerobic organisms. It has been shown that numerous organisms of the anaerobic group are to be found in the average normal individual. The rapid multiplication of these organisms in a stagnant intestine vitiated by a depressed circulation, would not be surprising, nor is it unlikely that the toxic products of the growth of these organisms has a profound influence on the general condition of the patient.

The clinical picture of a typical postoperative intestinal obstruction is shown in Case III. After a period of uneventful convalescence which may be as short as four days, the patient may suddenly complain of severe, agonizing abdominal pain. The onset of pain may be of startling abruptness. In Case V, the pain came suddenly enough to interrupt a sentence and clip a word in two. Such severe pain is usually of short duration, giving way to a general soreness in the upper abdomen or about the incision, which in a few minutes reaches a crescendo of acute pain. Paroxysms of pain follow one another with definite regularity. Immediately preceding the acute period of pain, peristaltic waves are to be seen in some cases, and even during the quiescent periods, a stethoscope on the abdomen reveals the boiling within. Very soon after the onset of the pain the patient vomits, first the gastric contents and then green, bile-stained, mucus. At first there is usually no abdominal distention. These symptoms are definitely indicative of small intestinal obstruction and immediate treatment is imperative.

Postoperative obstructions involving the colon, and especially the sigmoid as in Case II, are marked by less startling symptoms. Pain may be a less prominent symptom and its paroxysmal character only elicited after careful questioning. Even if this pain is overlooked suspicion of an obstruction must be aroused by the interruption of the fecal stream. Perhaps no other fact alone illustrates as clearly

the need of care of the toilet of the colon in postoperative cases. Vomiting is always a late symptom in obstruction of the colon. Distention, gradually increasing in extent is the rule, but associated with it is an active peristalsis which sometimes may be seen but always may be heard with the stethoscope.

If these symptoms supervene on about the ninth or tenth postoperative day one must be suspicious of a fecal impaction. Each postoperative case should be given an enema every day unless a satisfactory spontaneous evacuation has occurred: in spite of such a "standing order" it occasionally happens that fecal matter is allowed to accumulate and become inspissated, particularly if the intestinal activity has been slowed by morphine. This condition can be ascertained from the clinical notes and occasionally the impaction can be felt through the rectum. The treatment is obvious. This never occurs if the funnel drip is used.

In the treatment of paralytic ileus and intestinal obstruction it is necessary first of all to detoxicate the patient. This can best be done by intravenous injections of 10 per cent glucose. If there has been considerable vomiting the glucose is given in normal salt solution, irrespective of whether there is a decrease of the blood chloride. A liter of this solution is given twice a day. Intramuscular injections of glucose should not be given in a concentration of over 5 per cent. We very rarely give glucose by this method.

Patients showing abdominal distention due to a paralysis of the intestine are further treated by large hot abdominal compresses and almost continuous flushing of the colon with normal salt solution. Between the frequently repeated colon flushings the funnel drip remains in operation. Enemas of milk and molasses are occasionally given, and to be efficacious these should be of 1000 to 1500 c.c. volume. Injections of surgical pituitrin (1 c.c.) are occasionally given, but the use of drug as a routine is not to be recommended. If the slightest sus-

picion exists of the presence of an organic intestinal obstruction the use of pituitrin is absolutely contraindicated. Gastric lavage should be practiced early before the patient begins to vomit. The removal of gastric contents gives great relief, and the stomach should be kept empty. This may be done by passing a duodenal tube which is left in the stomach and through which irrigations with normal salt are made every thirty minutes. In some cases we have employed the Cornell continuous suction. It is rarely necessary to subject the patient to jejunostomy for the relief of this condition. The incision and drainage of loops of lower small intestine serves to collapse only the loop that is drained, but as a therapeutic measure is useless.

With the sudden postoperative appearance of symptoms of intestinal obstruction immediate operation is indicated. Case v was operated on two hours after the onset of symptoms. Morphine should not be given until operation has been offered and accepted by the patient. In recent postoperative cases the best approach is through the previous incision. If the previous abdominal wound is completely healed, the incision should be made about an inch to one side. The site of obstruction is usually felt without difficulty, and must be relieved. It is surprising how firmly organized adhesions may become in a very few days. The technic of freeing the obstructive condition must vary with the operative findings. Fiddle-string adhesions are cut and the points of attachment buried with a purse-string suture. Broad adhesions are divided with sharp dissection and an endeavor made to cover raw surfaces.

After obstruction of the small intestine has supervened for some hours it is our practice to insert into the dilated loop of jejunum a catheter which is carried out through the abdominal incision. Irrigations with normal salt can be accomplished through this channel. Although "milking out the dilated intestine" has been advised by many surgeons, we have felt that this

treatment involves too much manipulation for safety.

In obstructions of the large bowel drainage of the small intestine is also accomplished by jejunostomy. In cases of long standing obstruction with marked toxemia, where an attempt to free the obstructing adhesions seems hazardous on account of the condition of the patient, a jejunostomy should be performed through a small high left rectus incision. This procedure may carry a patient out of the acutely toxic period and allow the obstruction to be relieved with safety at a later date. It is frequently noted that after the small intestine has been drained, and the intra-abdominal pressure reduced, as by an ileostomy, jejunostomy, or cecostomy, an apparently complete bowel obstruction will allow fluid and gas to pass.

We consider that the treatment of the conditions discussed above is definite and positive. In abdominal distention (due to ileus or peritonitis) without obstruction, gastric lavage, compresses to the abdomen, colon irrigation and intravenous fluid medication are instituted. If from the increasing pressure, fluid keeps flowing into the stomach, and gastric lavage proves unsatisfactory, jejunostomy is indicated. If the stomach can be kept properly emptied, jejunostomy gives no added advantage. The stomach tube must be passed early.

In intestinal obstruction operation, with or without drainage of the intestine, is indicated as early as possible. Conservative treatment, "Waiting for a kink to unwind" is dangerous, and is usually based upon a lack of careful consideration of clinical symptoms.

The following cases typical of post-operative obstruction, developing soon after operation, have been selected as illustrations:

CASE 1. Operation, St. Luke's Hospital, January 19, 1924, cholecystectomy. Discharged from the hospital on February 2, 1924. Readmitted on February 15, with history of repeated vomiting, and evidence of first partial and

later complete upper intestinal obstruction. Operation February 16 showed duodenum closely adherent to the lower surface of the liver and the gall bladder fossa, which caused complete obstruction of the duodenum. This adhesion was not separated, but a posterior gastroenterostomy performed. Convalescence uneventful.

CASE 11. Patient aged sixty-nine. Operation St. Luke's Hospital November 1, 1927. Low midline incision. Very large multilocular cyst presented, partly aspirated and delivered with long pedicle arising from left broad ligament. This was tied off and raw surfaces covered. November 4 the abdomen was moderately distended with gas, but fecal matter was returned by colon irrigation. November 5 colon flushes returned practically clear; some gas was passing but very little. The distention was increasing. Patient was nauseated and vomited a small amount of mucus. One thousand c.c. 10 per cent glucose in saline intravenous administered. November 6, 2:30 A.M. patient was having cramp-like pains. Distension still present, and peristaltic waves were seen passing across the abdomen. Occasional gas bubbles passed through the funnel drip. Operation November 6, 1927, 10 A.M. through old abdominal incision. Intestines were greatly distended, both large and small, but free from evidence of peritonitis. Small amount of serosanguineous fluid in the belly. In the left broad ligament the sigmoid was attached with organizing adhesions through a distance of about  $2\frac{1}{2}$  inches. When these adhesions were freed, sudden gurgling of gas was heard, indicating that the obstruction had been relieved. A catheter was sewn into a dilated loop of jejunum, drawn out through a gap in the omentum through the upper end of the wound, to make certain of upper intestinal drainage, should the sigmoid again close. Abdomen closed. During the next eight or nine days the patient continued to be moderately distended. Gas and fecal matter were passed. Intravenous injections of 1000 c.c. of 10 per cent glucose in saline were made twice daily for eight days, and once daily for the next seven days. Massive milk and molasses enemas were given frequently and produced the best results. This procedure is dirty but the most effective to iron out kinks and angles in lumen of the bowel. By the fourteenth day the patient was walking and left the hospital without

further complications on December 7. She has been entirely well since that time.

CASE III. Operation January 24, 1929. Dante Sanitarium, for two enormous fibroid tumors of the uterus and a cystic right ovary. Supravaginal hysterectomy and right salpingo-oophorectomy. Stump of cervix and right broad ligament peritonealized in the usual manner. Convalescence uneventful. Patient home on the 12th of February, 1929 (home 110 miles from this city). Returned to hospital on February 20 with a history of very severe abdominal pain, coming on suddenly on the evening of February 17. Patient vomited soon after onset of pain. Pain was paroxysmal in character, severe, had continued until her admission to the hospital. Her physician at her home told her she had a "kink which would straighten out." The vomiting became fecal and patient markedly toxic and dehydrated. When admitted to the hospital the patient was in marked acidosis, with deep stupor but could be aroused. Pulse of poor quality, about 100. Temperature subnormal. She was given 1000 c.c. of 10 per cent glucose in salt solution intravenously. Operation under ethylene anesthesia on February 20. Incision through dense clean scar of the old operation. Considerable clear, yellow fluid in the abdomen. Dense adhesions found binding the sigmoid over to the right of the cecum. The terminal ileum was angulated and obstructed in the right iliac fossa. After freeing this obstruction it was found that a small portion of the terminal ileum was bound down in the right iliac fossa by a congenital band of peritoneum which was separated with some difficulty. A catheter sewed in the jejunum was led out through the abdominal wound. Patient received a second glucose in salt intravenous infusion, but expired twelve hours later, a victim of delay and conservatism.

CASE IV. Patient was subjected to 2 cesarean operations. During the three or four years following the first cesarean operation the patient had frequent symptoms which were undoubtedly attacks of partial and almost

complete intestinal obstruction. These cleared. We were called upon to do a second cesarean operation, but at the time of this operation no exploration was made, since a long period of time had elapsed since the last attack of partial obstruction, and there seemed to be no indication for prolonging the cesarean operation by an abdominal exploration. Two or three days following the cesarean operation the patient developed complete obstruction of the small intestine. This condition called for another abdominal operation. On opening the abdomen it was found that the mesentery of the transverse colon was tightly adherent to the posterior parietal peritoneum and was pulled down before the ligament of Treitz, leaving a small ring through which more than half the small intestine had herniated. This hernia had never become completely occluded until the distention occurred, which followed the insult of the cesarean operation, with its associated postoperative ileus. At the time of operation this hernia was angulated sufficiently to completely block the bowel in this ring.

CASE V. Aged twenty-four. Operation St. Luke's Hospital March 13, 1930, for right ovarian cyst and chronic appendix. Low, mid-line incision. Right ovarian cyst and appendix removed in routine manner without difficulty. Abdomen closed. Convalescence entirely uneventful. Temperature normal. Pulse 80-90. Patient allowed up and around ward on the tenth day. On March 23 at 8:00 P.M. patient had sudden onset of excruciating pain in the right lower quadrant and vomited dinner eaten at 6:00 o'clock. Vomitus continued until operation at 10:00 P.M. Pains definitely paroxysmal and very severe. Abdomen sore between paroxysms which came every two or three minutes. Peristaltic waves seen. Operation March 23 at 10 P.M. through old incision. Two adhesions of the ileum found to the cecum, with a loop herniated through the space between these and also attached. These adhesions were very well organized and were freed with careful knife dissection. Raw surfaces peritonealized. Postoperative convalescence entirely uneventful.



# ACUTE DILATATION OF THE STOMACH\*

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ACUTE dilatation of the stomach, a rare primary lesion, is seen by far most commonly as a sequel to laparotomy. McIver<sup>1</sup> has shown experimentally that this phenomenon may take place at any time under general anesthesia where there is a possibility of the free passage of air through the esophageal orifice, and this is the probable explanation of its occurrence in the majority of cases where the site of operation is extra-abdominal.

The dilatation itself is of the nature of an acute paralysis of the gastric walls and, though occasionally limited to the stomach alone, it is more frequently accompanied by similar changes in the upper intestinal tract. Whether or not the primary paralysis was caused by air drawn into the stomach during anesthesia, the atonic viscus soon contains secreted, imbibed or regurgitated fluid. Probably the most common cause of the gastric paralysis is infectious material in the abdominal cavity and in these instances the duodenum and jejunum are invariably similarly involved. It will be found, moreover, that a varying degree of gastric dilatation is responsible for, or at least intimately associated with, the stormy convalescence seen, and often otherwise unexplained, in clean operations upon the lower abdominal structures or the bile passages.

In most instances, the diagnosis is not difficult. The blown-up, drum-like abdomen with visible or palpable tumor mass on the left side; the constant effort to bring up gas, sometimes in vain, sometimes with copious and recurrent eructations, often with foreboding hiccough, are signs which should lead any observer to a correct interpretation of the underlying condition. In its earlier stages the process is not so easily determined, as the stomach is not entirely lacking in tone and the most

common symptom is frequent effortless vomiting, usually of clear or slightly bile-stained fluid. If, at this time, proper treatment is instituted we shall seldom see the extreme condition first pictured. However, if the condition is allowed to progress, symptoms of toxic absorption from the paralysed stomach and duodenum overshadow those of mechanical origin, and the face rapidly becomes ashen or even cyanotic, the pulse becomes rapid, respirations are rapid and shallow, and shortly before, sometimes just after death, immense quantities of blackish-brown or dull greenish fluid flow from mouth and nostrils. The outflow, which gushes rather than is vomited, is caused by the gas associated with the condition and not by active contraction of the stomach musculature.

Acute dilatation of the stomach, looked upon with so much alarm by early writers, should no longer be counted as a possible cause of death. The suspicion that such a condition exists can be verified by the passing of a duodenal tube and treatment for its relief can be as simply carried out. Gastric dilatation cannot cause death unless, unsuspected, it remains untreated.

Having suspected its presence, a duodenal tube of the Levin<sup>2</sup> type may be slipped through the nostril and passed into the stomach without difficulty. If the tube has been well lubricated with petrolatum, jelly or glycerine, it is unnecessary to cocaine the nose or throat though this is sometimes advisable in a nervous or excitable patient. Five per cent cocaine on an applicator is the local anesthetic of choice. By the use of the tube described, the stomach may be kept continuously empty without the oft repeated, distressing gastric lavage through a large stomach tube. Moreover, there is ample evidence to show that the stomach once

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emptied by gastric lavage refills rapidly with regurgitated and secreted fluid unless a continuous mild suction is maintained.

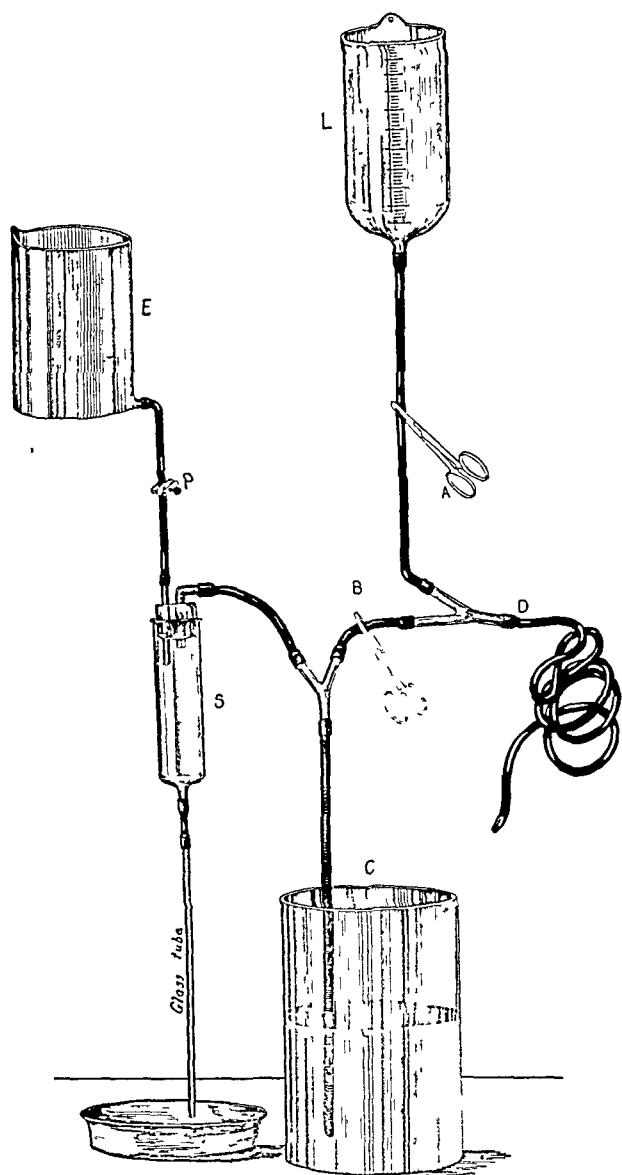


FIG. 1. Apparatus for Continuous Gastric Drainage. D, Levin duodenal tube, No. 14 F., to be slipped through nostril. A, hemostat clamped on tube to lavage solution, L, which is changed to B only during lavage; C, drainage tube, the end of which must be kept submerged; S, Connell suction apparatus, the barrel of a triumph syringe fitted with two-holed rubber stopper. Constant dripping from container, E, regulated to about 100 drops per minute by petcock, P, causes a mild negative pressure due to air bubbles carried down the glass tube between drops of water.

For the application of this suction we have devised an apparatus as illustrated in the accompanying diagram (Fig. 1). This method<sup>3,4</sup> has been used for more than five years in the Surgical and Gynecologic

Service of the University of California Hospital and we feel it has saved many lives. It has been used in paralytic ileus, which may or may not be due to peritonitis, in intestinal obstruction, in acute gastric dilatation and even in persistent postoperative vomiting not accompanied by dilatation or ileus. Its manifold advantages, pointed out by Brown<sup>5,6</sup> are: (1) Relief from conditions caused by gas and regurgitated fluids is obtained. (2) There is either interrupted or continuous lavage of the stomach and, in some cases, of the duodenum. (3) Nausea and toxemia are relieved. (4) The patient may drink water freely, relieving that most distressing symptom, thirst. (5) Transgastric feeding and medication are made possible. (6) The patient is so much more comfortable that he often begs for the return of the duodenal tube after having once experienced the relief afforded by its use.

When gastric or duodenal drainage is prolonged, care must be taken to prevent alkalosis. Because of long continued drainage, large amounts of chlorides, secreted into the stomach as hydrochloric acid, are lost to the system and alkalosis results. These chlorides must be replaced by massive subcutaneous injections of normal saline solution. In this way the ominous drop in blood chlorides is prevented and the fluid balance of the body is maintained. Normal or 4 per cent sodium chloride solution should replace bicarbonate of soda solution for gastric lavage. Glucose should be administered intravenously for its nutrient value if food by mouth is withheld for long.

#### SUMMARY

Acute gastric dilatation, formerly considered a serious and frequently fatal complication, should no longer be a possible cause of death. Suspicion of its presence should lead to a speedy test by transnasal insertion of a duodenal tube. Treatment by the apparatus for continuous gastric drainage herein described is simple and rapidly efficacious.

[NOTE: For references see authors' reprints.]

# PREOPERATIVE AND POSTOPERATIVE THERAPEUTIC USE OF DEXTROSE (GLUCOSE)\*

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**D**EXTROSE or glucose as it is more commonly known, is one of the most important therapeutic agents developed within recent years. The underlying basis for its use is simplicity itself, because "in any diseased state nothing could be much more fundamental as supportive treatment than to supply a patient with food and water in such a form and by such a route that these are immediately available to the starved and thirsty tissues."<sup>1</sup>

During the past five years or more much has been written about the surgical aspects of the use of dextrose. On reading over the literature one is struck immediately by the diversity of ideas expressed and opinions offered regarding certain essential matters such as indications, dosage, good and bad results, and whether or not insulin should be added, to say nothing of the general disregard of how very slowly intravenous injections of dextrose *must* be given in order to obtain full therapeutic effects and to avoid various undesirable consequences.

Probably this is due to the rapidity with which this old-new agent has sprung into its present prominence so that many of us using it still fail to appreciate that a dose of dextrose is a determinable matter definitely governed by rules of rational therapeutics. For example, a recent publication on the intravenous use of dextrose under certain conditions would be of inestimable value except that the author advises its injection by means of a modified blood transfusion outfit, apparently as rapidly as it can be pumped in. Such a method entirely disregards the consequent strain on the renal threshold, the wasteful spill of sugar through the urine, the hyper-

insulinism and reactions from overstimulation of the pancreas, possible overloading of the weakened heart muscle, as well as the incontrovertible fact that the therapeutic effect of the dextrose is dissipated and lost in direct ratio to the excessive rate of its injection (or faster than 0.8 gm. per kilo body weight per hour).<sup>2</sup> This same author would say nevertheless that he obtains good effects with his ways and of course some benefits are to be expected, but it may be pointed out that his results would be still better from the same dose properly given, the effects less erratic and uncertain, and the glucose reactions which he does not detail could be entirely avoided by the observance of a proper technic.

In this clinic as probably in many others the combination of obstetrics and gynecology in one service afforded an unusual opportunity for intimate contact and interest in the development of dextrose therapy as a standard treatment for the pregnancy toxemias, only to find suddenly that we had been carried along into an active application of this same agent to surgical gynecology. We use it preoperatively by mouth as a preventive of post-anesthetic nausea, vomiting and acidosis; each major operative case is routinely given at least one intravenous injection of hypertonic dextrose solution as an immediately postoperative procedure; we object, with valid reasons, to the addition of insulin for these non-diabetic patients since we believe that it is not more insulin to burn up available sugar which is required, but rather more sugar to be burned, whilst the patient is perfectly capable of forming in her own pancreas all and more than all the insulin she

\*From the Department of Obstetrics and Gynecology, St. Margaret Memorial Hospital, Pittsburgh. The technical phases of this work were conducted under the generous provisions of the John C. Oliver Memorial Research Foundation at the St. Margaret Memorial Hospital. Submitted for publication April 28, 1930.

needs; we regulate our dextrose dosage and rate of administration; and we do not have reactions.

It is similarly used in other divisions of this hospital and our services are notably free from such postoperative complications as even ordinary vomiting, acidosis and shock. Moreover, patients thus treated react from the operation more favorably and promptly, do not complain of thirst or nausea, and actually seem to regain even their intestinal peristaltic tone more promptly than in former days.

#### GENERAL CONSIDERATION OF DEXTROSE THERAPY

A knowledge of certain fundamental facts regarding dextrose metabolism and dextrose therapy is essential in order to obtain uniform results from its use. These can best be discussed in a briefly tabulated form:

*Dextrose and Glucose:* Originally the word glucose was synonymous in a chemical sense with dextrose. Practically, however, there was a great difference because then, as now, glucose was prepared on a large scale for commercial purposes. Glucose sold as such over the druggist's counter still contains various impurities, and reactions and even deaths have followed its intravenous use.

It was on this account that in the Tenth Revision of the U. S. Pharmacopeia in 1926 need was realized for the establishment of certain fixed standards. At this time the term *dextrose* was officially adopted and listed for that sugar so prepared and purified that it could be used for all therapeutic purposes.

The medical use of the term glucose is no longer correct, therefore, because glucose is the impure commercial sugar or syrup, and one should speak now only of dextrose in referring to the medicinal agent which has so commonly been called glucose.

For intravenous use chemically pure dextrose is no longer necessary if "dextrose, U. S. P. X." is specified.

Reactions following the intravenous use of dextrose solution are unnecessary and avoidable<sup>3</sup> providing no technical errors are allowed in its preparation or its administration. Safe solutions are easily prepared in any hospital, or recourse may be had to one of the many hermetically sealed ampules of dextrose solution now on the market providing they contain no cresol as a preservative. These may be employed without risk of reactions unless the operator fails to use freshly distilled and immediately sterilized water in their dilution, or else gives the solution too rapidly, or too cold, or in overdose.<sup>1,4</sup>

*Modes of Administration:* Dextrose in solution may be given by mouth, by rectum, subcutaneously or intravenously.

The first two routes probably require little or no comment but certain points common to the latter two need some clarification.

Dextrose solution in itself is not especially irritating when given subcutaneously regardless of its concentration, and when sloughs occur as they occasionally do these are probably the result of pressure necrosis from having been injected too rapidly.

These necrotic sloughs were more common formerly, before the days of intravenous injection, when submammary infusion was the only substantial route of extraoral administration. One probable cause has been alluded to, but it will be remembered that "glucose and soda" was a favorite combination in solution. Bollman<sup>5</sup> has pointed out that alkalies cause a rapid disintegration of glucose or dextrose when heated, so that they should never be added to the sugar solution before sterilization. This and the chemical degeneration of sodium bicarbonate into the more caustic sodium carbonate under sterilization are probably additional factors in the causation of these sloughs.

In any event it is apparent from the foregoing that sodium bicarbonate has no place in combination with dextrose solutions for intravenous injection, and in



fact also should not be used for subcutaneous infusion if such a method of administration of dextrose must be employed.

By the intravenous route underdosage and over-rapid injection are grievously common faults. The consequences of the latter have already been alluded to in an earlier paragraph.

Regarding dosage careful investigations<sup>1</sup> have disclosed that a single therapeutic dose of dextrose for an average sized adult is approximately 75 gm. The maximum rate at which this should be given is 0.8 gm. per kilo body weight per hour<sup>2</sup> in order to have it completely utilized by the body. Translated this means that such an injection of an average therapeutic dose to an average sized adult requires approximately one hundred minutes or *one and three-quarter hours!*

More than this amount at this maximum rate is likely to overstimulate the pancreas in its insulin-producing capacity resulting in an endogenous hyperinsulinism accompanied by hypoglycemia and actual reactions from this source. The same ill result is to be expected even more constantly from the intravenous drip of Matas<sup>6</sup> or venoclysis as it is called by Hendon<sup>7</sup> unless the rate of injection is reduced in these prolonged injections to about one-third that speed at which single therapeutic doses can be given. Hendon even reduces his dosage to one drop per patient's pulse beat.

The fallacy of adding insulin to such injections of dextrose in these normal non-diabetic individuals is emphasized by these important facts.

The strength of the dextrose solution to be chosen depends on various factors such as the condition of the myocardium, the degree of dehydration, acidosis, etc. My own preference for single doses is 300 c.c. of 25 per cent solution, since the effects of the hypertonic solutions seem more prompt and more pronounced. A 15 or 10 per cent solution may be used (500 to 750 c.c. respectively) if more water is required.

For prolonged venoclysis the solution should not be stronger than 5 per cent but this injection may be continued even for days if, as said before, the rate of injection is reduced to one-third the maximum of the Woodyatt and the Wilder and Sansum formula or, not more than 5 or 6 c.c. per minute. Gallie and Harris<sup>8</sup> say that they prefer salt solution for this purpose because dextrose solutions may result in thrombosis of the veins if the injection is prolonged. My own belief is that this objection is largely theoretical while the therapeutic value of the dextrose is greatly superior to that of salt; moreover such injections have been employed in our hospital a vast number of times without any such difficulty.

It is also essential in the prevention of reactions to maintain heat in the solutions during their injection. The administration of cold solutions is probably a frequent cause of reactions.

#### INDICATIONS FOR DEXTROSE ADMINISTRATION

**PREOPERATIVE:** In all elective operations the patient should be directed to increase the carbohydrates in his food for a period of several days before his operation. Well sweetened orange juice, or other fruit juices with cane sugar or powdered dextrose should be freely drunk; honey may be eaten with meals; light desserts including ice creams and fruit ices are advisable, and clear hard candy (no chocolates or bon-bons) may be eaten after meals.

The patient's carbohydrate reserves will thus be built up in advance; the anesthetic will be less toxic, and postanesthetic nausea and vomiting will be materially lessened by this preliminary preparation.

In such surgical emergencies as traumatic shock, intestinal obstruction, or prolonged preoperative infection as from prostatitis or certain cases of cholecystitis, an intravenous injection of dextrose solution with or without the addition of sodium chloride (depending on the presence or absence of vomiting with loss of chlorides)

should be given while getting ready for operation. In these instances the injection should preferably be made of one of the weaker solutions given fairly rapidly. This supplies the necessary volume of fluid but still need not exceed the formula of Woodyatt, and Wilder and Sansum for the introduction of the sugar.

Many a bad operative risk can be turned into a fairly safe surgical venture by a judicious period of preoperative preparation in which dextrose injections properly chosen and properly carried out play an important rôle.

**POSTOPERATIVE:** Postoperative indications for intravenous dextrose administration are three fold: (1) Routine supportive treatment as a restorative measure, or as preventive or active treatment of vomiting and (2) preventive, or active treatment of shock. These are immediate postoperative indications, whereas there is a third group having slightly more remote relationship to the operation. In those cases (3) where peritonitis is a complication as following a ruptured appendix, or peritonitis with profound toxemia as with intestinal obstruction this treatment gives some of the most spectacular results which are to be seen in any class of cases. Post-anesthetic pneumonia<sup>9</sup> as well as acute nephritis with urinary suppression also fall into this third group.

Probably the simplest way of considering these conditions and their treatment in detail is to outline them in tabulated form as follows:

**Group I.** Routine Postoperative Injection as a Restorative, and as a Preventive or Active Treatment of Vomiting and Acidosis:

1. As routine postoperative measure; 300 c.c. of 25 per cent dextrose solution injected intravenously at 3 c.c. per minute. Repeat once or twice if necessary at four to six hour intervals.

2. This is also preventive treatment of postoperative vomiting.

3. If treatment is instituted promptly the same procedure outlined for routine

injection should be vigorously pushed for postoperative nausea and vomiting. If vomiting has been excessive before treatment is begun add to solution 1 to 2 per cent sodium chloride to compensate for loss of chlorides in emesis.

4. Proctoclysis of 10 per cent dextrose or of tap water by Harris tidal-stand method is preferable to the Murphy drip.

**Group II.** Preventive or Active Treatment of Shock:

1. After prolonged operation give 400 c.c. 20 per cent solution of dextrose intravenously at 4 c.c. per minute, with intrarectal injection of one pint of hot dextrose (10 per cent) with sodium chloride (2 per cent). Repeat intravenous injection once or twice at from four to six hour intervals if necessary.

2. Active treatment of postoperative shock; 750 c.c. of 10 per cent dextrose solution intravenously at 7.5 c.c. per minute, or if more haste is necessary 750 to 1000 c.c. of 5 per cent dextrose solution with 1 per cent sodium chloride at 15 c.c. per minute; or 500 c.c. gum acacia and dextrose solution at about the same rate.

Valuable time should not be wasted on attempts at venopuncture. The veins are frequently so collapsed as to be difficult of access by needle and should be cut down upon without delay. The observance of the technic of Larkin,<sup>10</sup> of lifting a triangular flap in the vein, and then closing the wound with an encircling suture tied in a bow-knot after the injection is ended makes it possible to use this same vein anumber of times for subsequent injections if necessary.

**Group III.** Suspected or Actual Peritonitis, Intestinal Atony or Beginning Ileus, and Toxemia Following Intestinal Obstruction.

1. With suspected or local peritonitis give 300 c.c. of 25 per cent dextrose solution intravenously at 3 c.c. per minute repeated after four to six hours for day or two. With general peritonitis of mild degree this same procedure will be sufficient, and this is also true of intestinal atony or beginning ileus.

2. If these conditions have existed for some time or are of serious degree and do not respond quickly and sufficiently, change to prolonged intravenous administration (venoclysis) giving 5 per cent dextrose solution through tied-in cannula at about 5 c.c. per minute. Continue this over period of several days without interruption. In cases of marked peritonitis where vomiting has been severe, and especially after operation for intestinal obstruction from 1 to 3 per cent sodium chloride should be added, until blood chlorides are restored to normal.

3. Following operations for intestinal obstruction venoclysis of 5 per cent dextrose solution with or without 1 to 3 per cent sodium chloride is not merely recommended but urged as a routine procedure. This should be continued as long as five or six days if necessary.

It is, of course, understood that the foregoing is merely an important addition to other rational methods of treatment already established, and it is probably unnecessary to point out that there are many other surgical indications for the use of dextrose, particularly by the intravenous route. The occasions for its use will constantly suggest themselves to the surgeon who keeps in mind the fact that food and drink are essential to any individual, and that to furnish such elemental but

necessary support to a patient who is seriously sick may frequently be the determining factor between his recovery and his death.

#### SUMMARY

1. The preoperative and postoperative administration of dextrose (D glucose) is now regarded as of great importance in the general care of the surgical patient. Intravenously injected dextrose will frequently convert the bad surgical risk into a comparatively safe surgical venture.

2. Administered preoperatively by mouth or by vein as necessity may require it acts as a preventive of postanesthetic nausea, vomiting and acidosis.

3. Routine postoperative intravenous injection of hypertonic dextrose solution is recommended in the prevention of vomiting, acidosis and shock, intestinal atony, etc.

4. Dextrose solution injected intravenously is effective supportive treatment for traumatic shock, peritonitis and the toxemia of intestinal obstruction.

5. Modes of administration, dosage and indications for dextrose therapy are discussed in this paper.

6. The assertion is again made that unfavorable reactions from intravenous injections of dextrose are avoidable if certain technical but simple essentials are understood and observed by the operator.

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# POSTOPERATIVE SALIVARY GLAND INFECTIONS\*

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**A**MONG the complications which may ensue after surgical endeavor, acute salivary gland infections rank low in incidence but high in actual and potential danger. Whether or not its occurrence is an indication of low resistance, whatever its etiology may be, its significance is always sinister.

Much has been written on this topic, notably the parotid gland involvement, because it is the most common, far exceeding submaxillary and sublingual in frequency. A review of the literature by the writer in 1923, disclosed contributions by surgeons of many countries, from Paget in the eighties of the last century down to our time. These surveys indicated no unanimity of opinion as to etiology, but did point out its seriousness, all concurring that the average mortality was about 30 per cent. The accurate computation of mortality is difficult, because the condition so frequently manifests itself as a complicating factor in a patient already gravely sick.

The literature since 1923 has been similarly reviewed. A number of writers have contributed scholarly studies of this most distressing lesion. They, however, have shed no light on the causative factor. Speculation continues as to whether it is hematogenous, ascending (via salivary ducts), traumatic (by anesthetist), or lymphatic. The preponderance of evidence leans to the first two. It is pointed out that trauma in general, in industry, in boxing and other rough sports, is not followed by parotitis. As for lymphatic approach, the parotid lymph nodes derive lymph only from the gland itself, the external ear and eyelids, which makes it doubtful that the infection reaches the gland through lymphatic channels.

There is much evidence to support

both the hematogenous and ascending etiologic concepts and it may well be in many instances that a combination of both factors enters into its genesis. The adherents of the ascending or ductal theory base their arguments on a dry mouth, salivary stasis and the fact that cultures from the gland, Stenson's duct and the mouth are identical in postoperative parotitis. Complementing this is the observation that the inflammatory process begins in the center of each lobule. Resemblance to ascending biliary, urological and mammary infections is also advanced in support of this theory.

However, postoperative patients generally suffer from dry mouths and some degree of salivary stasis, if not oral sepsis. If these factors are potent, salivary infections should be more frequent. The fact that the invasion is so generally of the parotids is explained on the hypothesis that saliva produced by the sublingual and submaxillary glands is more bactericidal than that of the parotid and also that the ducts of the former open under and are kept clean by movements of the tongue. Stenson's duct opens outside the alveolar process, near the molar teeth, which are frequently carious.

The rapid onset after operation, the extent of the involvement and the associated septic symptoms, on the other hand, point to a hematogenous source, entirely apart from those instances, in which the occurrence is manifestly pyemic.

The diagnosis offers no difficulty as a rule. A tense, tender swelling develops in front of either ear. The skin is red. The swelling is painful. There is a rise in temperature, with associated prostration and discomfort. Such is the familiar picture of acute parotitis.

It may slowly subside on the involved

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## POSTOPERATIVE SALIVARY GLAND INFECTIONS (ST. CATHERINE'S HOSPITAL)

Disease and Operation	Age	Sex	Nativity	Involvement	Length of Time Post-op. (Days)	Incision	Culture	Hospital Stay (Days)	Other Complications	Result	Diet Post-op.	Mouth Throat
1925 Chronic appendicitis Chronic cholecystitis Appendectomy and cholecystectomy Wound clean	22	M.	U. S.	Left	10	No	None	41	None	Cured	Fluids	Teeth and tonsils good
Ureteral calculus Ureterotomy Wound infected	41	M.	U. S.	Both	8	No	None	34	None	Cured	Fluids	Teeth fair
Incision and drainage Acute appendicitis Acute gen. peritonitis Patient very ill on admission, T. 104° F. Parotid cleared up after 11 days. Patient lived 18 days after.	53	F.	Ireland	Left	25	No	None	54	Pelvic peritonitis General sepsis	Died	Fluids	Teeth poor
1926 Strangulated umbilical hernia Repair, wound infected	58	F.	U. S.	Both	6	No	None	10	Fecal fistula	Died	Fluids	Teeth very poor
Acute appendicitis Acute gen. peritonitis Appendectomy Wound infected	14	M.	U. S.	Left	13	No	None	29	Secondary hemorrhage of wound	Died	Fluids	Teeth good
Acute perforated appendix Acute local peritonitis Appendectomy Wound infected	26	M.	U. S.	Left	3	Yes	None	28	None	Cured	Fluids	Teeth fair
Cholelithiasis Cholecystectomy Wound clean Parotitis subsided after 5 days	58	F.	U. S.	Left	3	No	None	20	Secondary hemorrhage from wound	Died	Fluids	Teeth good
Acute appendicitis Incision and drainage for app. abscess Wound infected	69	F.	Italy	Right	6	No	None	12	Pulmonary embolism Diabetes	Died	Fluids	Teeth fair
1928 Perforated duodenal Ulcer Excision and suture Wound clean	49	M.	Russia	Both	4	No	Staph. albus	11	Wound rupture General sepsis	Died	Fluids	Teeth poor
Toxemia of pregnancy Cesarian section Wound clean	30	F.	U. S.	Right	7	Yes	None	27	None	Cured	Fluids	
Intra-abdominal Abscess Incision and drainage Wound infected	63	F.	U. S.	Both	4	No	None	16	None	Died	Fluids	
1929 Inguinal hernia Hernioplasty	10	M.	U. S.	Both	2	No	None	15	None	Cured	Fluids	Teeth poor
Chronic appendicitis Appendectomy Wound infected	16	F.	U. S.	Both	5	Yes	Staph. aureus	27	None	Cured	Fluids	Teeth good

side as it appears on the opposite side. The latter may quiet down and the original side again become active. Suppuration may or may not occur. If it does, spontaneous drainage may eventuate through the external auditory canal, the temporal fossa or the pharynx.

Prophylactic treatment emphasizes the

necessity of adequate oral hygiene before and immediately after operation. Careful cleansing of the mouth, keeping the oral mucosa as moist as possible, postponing elective operation in the presence of bad oral hygiene are all important.

Once it develops, iodine and ice locally are useful, chewing gum or acidulous

lozenges (lime or lemon) are helpful in stimulating a flow of saliva. The free intake of fluids is essential and in the bad cases, hypodermoclysis is beneficial.

If pus forms, obviously drainage is necessary. Incision may be made at the level of the angle of the inferior maxilla, keeping in mind the location of the facial nerve. It should preferably be horizontal and once the dense sheath is opened, the gland proper may be entered with a blunt forceps.

Fisher,<sup>1</sup> in a recent study, advocates the daily intravenous use of 5 per cent mercurochrome. He considers it effective, especially in those infections due to staphylococci, often aborting a diffuse, destructive process. He also, when drainage is needed,

<sup>1</sup> Fisher, W. H. *Ann. Sur.*, 86: 445-448, 1927.

describes a Y shaped incision, one arm of which begins at the zygoma, the other at the mastoid, both joining below the angle of the jaw to continue down to the supraclavicular notch. The writer has had no experience with either, but believes they have merit.

A review of the records at St. Catherine's Hospital, for the past five years, discloses 13 cases with 7 deaths. Further analysis of the record removes 4 of the deaths for the reason that the parotitis was not a determining factor. In 1, the parotid infection subsided eighteen days before death, 2 had secondary wound hemorrhages and 1 died of embolism. The mortality in this group, as accurately as it can be estimated, is therefore about 24 per cent.



# SUCCESSFUL MOUTH TO MOUTH INSUFFLATION IN THE ASPHYXIATED ADULT

A NEW METHOD\*

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THERE is probably no emergency in operative work which is so demoralizing and fatal as acute asphyxia. The picture of the patient whose respirations are completely obstructed, who passes rapidly from cyanosis to lividity, dilated pupils, and finally, through muscle spasm to the complete relaxation of the antemortem state, is one which we can never forget.

In the face of this condition, what do we ordinarily do to meet it? Put a mouth gag between the teeth, pull out the tongue, do Sylvester artificial respiration, dilate the sphincter, give hypodermic injections, and make other gestures, usually without any result.

In a previous communication,<sup>1</sup> the writer has met this condition by laryngoscopy, suction, intubation and insufflation of oxygen  $\text{CO}_2$ . This method, which is growing in popularity in the resuscitation of the newborn, has also been found valuable in the adult.

The insufflation of oxygen and  $\text{CO}_2$  is of the greatest possible value after laryngoscopy and intubation. Facilities for intubation should always be available for use. A description of the author's pocket flashlight laryngoscope has previously been published<sup>2</sup> and the intratracheal tube employed has been described.<sup>3</sup> In the intervening three years, the writer has come to the conclusion that this equipment is as essential as the anesthetic agent. Its construction is so simple that it does not get out of order.

The following recent case illustrates the extreme value of immediate laryngoscopy and intubation in asphyxia, due to obstruction.

<sup>1</sup> FLAGG, P. J. Treatment of asphyxia in the new-born. *J. A. M. A.*, 91: 788, 1928.

<sup>2</sup> FLAGG, P. J. Exposure and illumination of pharynx and larynx, etc. *Arch. Otolaryngol.*, 8: 716, 1928.

<sup>3</sup> FLAGG, P. J. Intratracheal inhalation. *Arch. Otolaryng.*, 5: 394, 1927.

Patient, male, twelve years old. Manhattan Eye & Ear Hospital, N. Y. February 18, 1930.

Temperature: 105.6°F. Rather fat, with thick-set, short neck; previously anesthetized on February 9, 1930. The anesthesia at this operation was characterized by extremely rapid respiration, requiring a high percentage of oxygen to prevent cyanosis; air was given frequently without effect, in the hope of reducing the respiratory rate. Recovery had been prompt, without complication.

This anesthesia, the second, took place on February 18, 1930; gas oxygen without ether operation for jugular resection. The characteristic rapid respiration developed within a few minutes with a rate of between 50 or 60 a minute. It was impossible to bring down these respirations by the addition of oxygen or air. The jugular wound had been closed, attention was being directed to the mastoid wound; severe bleeding from sinus had just been controlled. A new incision was made posteriorly. At this time, the patient's respiration seemed to become obstructed as well as rapid; no pharyngeal tube had been used because of the extremely light anesthesia maintained; his color was cyanotic, and oxygen did not relieve the cyanosis. The neck seemed to be swollen and full. Removing the mask, I found the lower lip caught between the teeth which were tightly clenched. The cyanosis increased in spite of oxygen being offered to the patient. Anticipating an accident, I called for suction and my laryngoscopic apparatus. The draperies were thrown from the face; the lips were livid. The respiratory effort became weaker and weaker, and finally ceased. The pupils dilated and the clenched teeth relaxed. The small laryngoscope was introduced without difficulty. The soft parts of the airway were deep blue and completely relaxed. A quantity of mucus in the hypopharynx was removed and the glottis located. During this time, the surgeon was compressing the chest, but there was no exchange of air and no respiratory movement. The No. 7 intratracheal tube employed for anesthesia was intubated. There was slight tone of the cords which were closed, but there were no active reflexes and no spasm.

\* Submitted for publication, March 6, 1930.

I immediately blew forcefully into the tube, distending the patient's chest. At the crest of the insufflation, a convulsive inspiratory effort

The cause of this respiratory failure is thought to be due to continued anoxemia from nitrous oxide and oxygen (this

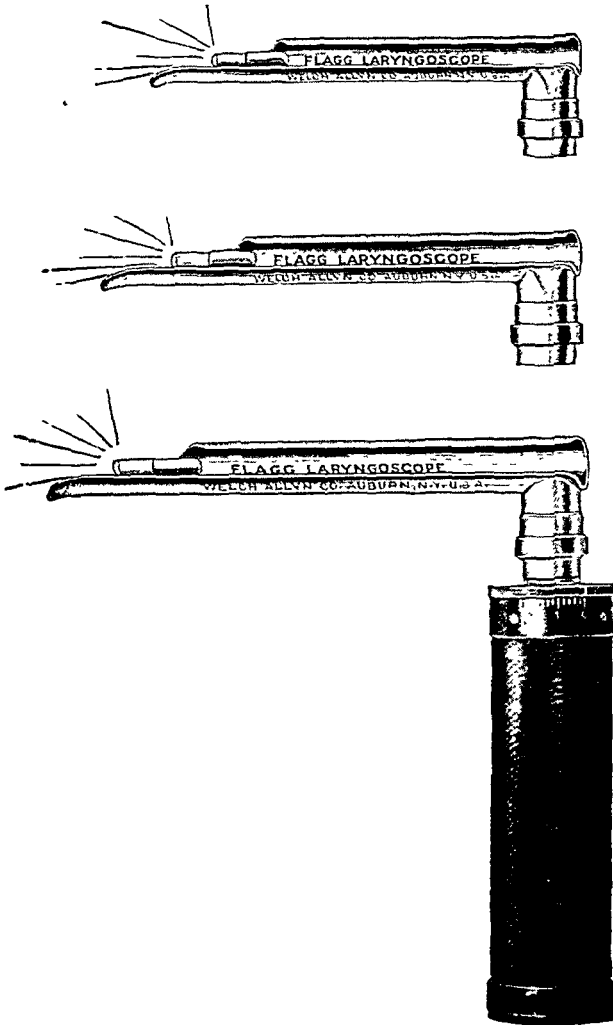


FIG. 1. Author's laryngoscope showing large, medium and baby specula.

of the patient's chest took place, as if to deepen the effects of my insufflation. Allowing the expiration to escape through the tube, I blew in again. The color improved at once; oxygen was then blown into the tube; the patient seemed about to breathe spontaneously, then did breathe through the tube. I insufflated once more, the patient's respiratory effort complementing my insufflation. The color became brilliant, a sharp laryngeal spasm developed from the presence of the intratracheal tube which was immediately extubated. The patient breathed deeply and forcefully and made convulsive movements of the face and body (anoxic jactitation in reverse order). The patient was then given a pharyngeal tube and pure oxygen with a little ether. The respiration slowed down, ether was stopped, and gas oxygen continued, the patient recovering consciousness on the table.

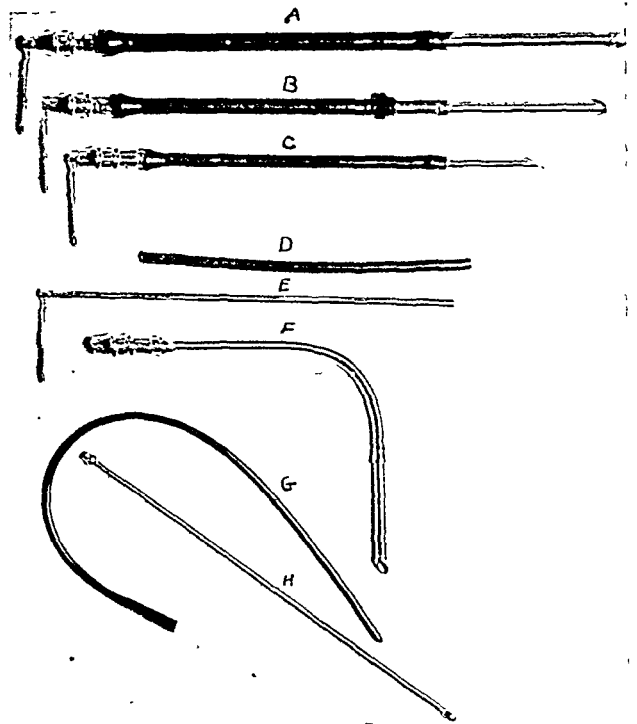


FIG. 2. A, No. 9 intratracheal inhalation tube. B, No. 7 intratracheal inhalation tube. C, No. 5 intratracheal inhalation tube covered with Penrose tubing. D, Penrose tubing. E, Obturator. F, Naked tube with obturator removed. G, Suction catheter of rubber. H, Intratracheal suction tube.

anesthetic having been chosen because of the fact that the patient had an acute nephritis and bronchitis), resulting in complete anoxemia through muscle spasm. The sequence of anoxemia, spasm, cyanosis, relaxation of the masseters and the glottis, dilated pupils, absence of respiratory effort and ineffectual artificial respiration by direct compression would certainly have resulted in death.

The curious phenomena of an inspiratory effort on the patient's part, at the crest of my direct mouth insufflation, rapid oxygenation, forceful expirations, rapid return of laryngeal reflexes upon oxygenation, within 6 or 8 breaths, and anoxic convulsions during recovery, all tend to confirm the condition as due to oxygen deprivation.

This patient's life was undoubtedly saved by prompt laryngoscopy, intubation and mouth insufflation.



# POSTOPERATIVE KIDNEY COMPLICATIONS\*

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**K**IDNEY complications are among the relatively rare but clinically very important sequelae of operations. The following 4 basic forms may be differentiated: (1) Disturbances in the function of the kidney, (2) inflammatory, non-infectious diseases, (3) infectious diseases of the kidney, and (4) the effects of changes in the efferent urinary passages upon the kidney.

*Postoperative disturbances of the function of the kidney*, which in the majority of the cases are transient but, under certain conditions, may also lead to the death of the patient, may be produced by inhibitory reflexes which originate in the other kidney or in the bladder, when these organs are operated upon. Under such conditions there results either a reflex angiospasm, or a sudden overloading of function through the removal of the relatively still well-functioning sister organ (tuberculosis, hypernephroma), or, finally, the various non-specific insults, which the operation as such exerts upon the organism. The importance of this latter factor, German surgery has learned to appreciate more and more, since it has been shown that some of the cases of postoperative fatality, which are usually attributed to the shock of the operation, are merely masked uremias; for this reason a kidney function test is always done before every major operation, especially laparotomy, in many of the surgical clinics.

*Postoperative, inflammatory, non-infectious diseases* of the kidney in the form of simple degeneration, nephrosis, or even nephritis are usually attributed to the anesthesia, but in general it may be said that the effect of the anesthesia, especially since chloroform is no longer being used, is markedly overestimated. Braun (Zwickau), who deserves the greatest credit for the introduction of local anesthesia into Ger-

many, repeatedly emphasizes the fact that operations on the kidneys are the very operative procedures that are best done under general anesthesia. It is certainly correct, that entirely intact organs are no longer subjected to the previously mentioned reflex as well as anesthetic injuries, but it must be emphasized repeatedly, that even predispositions are sufficient in this respect, which we cannot discover even with our best functional tests and methods of examination. A certain factor of danger, which cannot be relieved at the time, is inherent in every one of these operations.

*The infectious diseases of the kidney*, owing to the very frequency of their occurrence, demand by far the greatest amount of consideration. Inasmuch as one of the most important prerequisites of their occurrence are postoperative changes in the efferent urinary passages, particularly in the pelvis of the kidney and ureter, these two latter conditions in this classification may be discussed together.

In the first place, a few remarks on the pathologic-anatomic fundamental principles. There can no longer be any doubt today, that the entire urinary tract reacts to the most varying insults, particularly also to infections, as a unit. This means that urethritis, cystitis, ureteritis, pyelitis, pyelonephritis, abscess of the kidney and pyonephrosis, are merely different localizations, and under certain conditions, different stages of the same disease process. One sees sufficient cases in which the entire urinary tract is actually attacked by the infection. But in contradistinction to such a unitary conception one must not overlook the fact in other cases the localization of the infectious process in a single section of the urinary tract is so predominant, that the conception of the previously mentioned disease pictures as more or less

\* Submitted for publication, May 13, 1930.

isolated phenomena is absolutely correct. Inasmuch as the nomenclature in this field is by no means uniform, as a result of which there are basic difficulties in diagnosis, a few definitions of the terms used by us are in place. Under the term "pyelitis," we understand an inflammation of the mucous membrane of the undilated pelvis of the kidney; but if, on the other hand, the pelvis of the kidney is dilated, we speak of an "infected pyelectasis or hydronephrosis." Whereas the simple form of pyelitis always results from an ascent of the infection from the lower urinary passages, hydronephrotic infection may also arise in a metastatic way. A "pyelonephritis" is understood to be a suppurative inflammation of the interstitial tissue of the kidney, whereas the true parenchyma of the kidney is affected only secondarily in the advanced stages. In the fully developed cases one sees infiltrations of leukocytes in the transverse section of the kidney, which pass in the form of stripes along the urinary canaliculi from the cortex to the tips of the pyramids. Abscess formation may occur in any part of this course, most frequently at the surface of the kidney. This disease picture may be ascending, that is, reach the kidney itself from the pelvis of the kidney through an ascending infection, or a descending infection, in which case a metastatic cortical abscess forms at first from bacterial emboli in a glomerulus, from which the infection of the medullary substance of the kidney ensues. In the individual case a differentiation between these two modes of infection is hardly possible.

Formerly the colon bacillus was almost exclusively (up to 90 per cent of the cases) blamed as the exciting germ, but more recent investigations have shown that cocci of a great many types are constantly gaining greater importance (up to 40 per cent of cases) in the hematogenic infections and, particularly, in the sequelae of operative interventions, in which we are especially interested at this moment. In

this connection, brief mention is made of the fact that very recently the pathogenicity of the colon bacilli has again been questioned, a view that had previously been presented by Rovsing in 1898, but which had to be considerably modified later.

As is well known, predisposing factors also are always necessary for the occurrence of any infection. In the case of the occurrence of true renal infections, pyelonephritis and abscess of the kidney, these are practically unknown. *The indispensable prerequisite for an infection of the pelvis of the kidney, however, is a motor insufficiency with or without dilatation of the calyx-renal-ureter tube.* To speak more accurately, one would say: a prerequisite for a long-continued infection, as the acute infections of the mucous membrane of the renal pelvis, like every other superficial infection of a mucous membrane, shows a marked tendency toward a spontaneous recovery. A chronic suppuration originating from the renal pelvis, therefore, results only when this spontaneous recovery is prevented by complicating factors, and this happens almost exclusively as a result of a motor insufficiency of the efferent urinary passages and the backward stasis of the urine associated with it. *From this is drawn the clinically exceedingly important conclusion, that the diagnosis of "chronic pyelitis" as an independent disease picture is always a wrong diagnosis!* The chronic suppuration originating in the pelvis of the kidney is never an independent disease, but always merely a symptom, and the aim of the diagnosis is to determine what the factors are that prevent this tendency to spontaneous healing of the inflammation and favor the chronicity of the suppuration. Two pathologic factors enter into the discussion at this point, namely, the dilatations of the renal pelvis mentioned and the infection of the renal tissue itself.

According to the most recent status of investigations, I would like to differentiate 3 types of dilatations of the efferent urinary passages: (1) *congenital atony*, in which

group belong the frequently very large dilatations of the bladder, ureter and renal pelvis in the newborn, but even the hydronephrosis in movable kidneys is, in most of the cases, not a result of the renal dystopy but a phenomenon coördinated with it as a common expression of a universal hypotonia of the entire connective tissue apparatus; (2) *the mechanical dilatation* from peripheral obstruction of urinary outflow, and (3) *the adaptive relaxation*, by which term is to be understood the fact, that with moderate obstruction to the urinary outflow the renal pelvis and ureter reduce the tonus of their walls in adaptation to the changed dynamic conditions and consequently increase their capacity, without the wall being mechanically dilated or even overdistended. This is a very general compensatory mechanism, which we also see in other hollow viscera, for example, in the bladder with hypertrophy of the prostate, in the left heart with aortic stenosis, in the pulmonary alveoli with bronchial spasms, and numerous other conditions.<sup>1</sup> The functional character of these dilatations of the renal pelvis and the ureter and their difference from the definitive atony and dilatation is shown by the fact, that they may retrogress completely and permanently with suitable drainage therapy. The knowledge of this mechanism is of fundamental importance especially in the understanding and the treatment of the pyelitis of pregnancy and of the puerperium. Regardless of the type that has caused the accumulation of residual urine in the pelvis of the kidney, so long as it is present, it presents an absolute hindrance to the cure of the infection, and the first endeavor of every form of therapy consists in relieving the renal pelvis by intermittent or continuous drainage.

An infected residual urine in the pelvis of the kidney, therefore, is the primary cause of the chronicity of a renal pyuria; the second, as has been mentioned, is the

pyelonephritis. Whether there is such a condition as an uncomplicated pyelitis, that is, whether or not every infection of the renal pelvis is associated with a more or less extensive infection of the adjacent urinary canaliculi, is an important theoretical question; clinically, both of these conditions, pyelitis and pyelonephritis, can and must be sharply differentiated. In fact, we speak of a clinically important pyelonephritis when the kidney function shows only an indication of diminished function.

The diagnostic procedure in a chronic renal pyuria is, therefore, the following: In the first place, one should determine, with ureteral catheterization and possibly with the aid of pyelography, whether or not there is any residual urine in the pelvis of the kidney. If this is not the case, the chronicity of the pyuria can be due only to a pyelonephritis. In order to confirm this or in order to determine the extent of the destruction of the renal parenchyma, the simplest functional test with indigo carmine or phenolsulphonephthalein is sufficient. A further important differentiation of these two disease conditions is furnished by the clinical symptoms. Without going into any further detail, an almost universally made mistake should be corrected at this time: Pyelitis is never the cause of very severe pains or very high temperatures or even of a chill. *Every urologic disease having its onset with severe clinical symptoms, including high temperatures and chill, is due to either a metastatic infection of a previously formed hydronephrosis or, in the vast majority of cases, to the development of a metastatic cortical abscess in the kidney.* Inasmuch as the infections of the kidney following surgical intervention are almost always of hematogenic-metastatic nature, one may say, *that the embolic pyelonephritis represents the typical postoperative complication as far as the kidneys are concerned.* The sources of the infection are: the infected urinary bladder, from which the kidney may be infected both by an ascending and a

<sup>1</sup> Cf. SCHWARZ, O. Pathologische Physiologie der Harnblase. In: Handbuch der Urologie. Berlin, Springer.

metastatic route; every pus focus anywhere in the body; and, finally, the intestinal tract.

When we enter upon the discussion of the special pathology of postoperative infectious complications of the kidney, the term "surgical intervention" should be used in the widest possible sense. The simplest, but at the same time perhaps one of the most important of these surgical interventions is catheterization or the introduction of instruments into the urethra and bladder. It is a well-known fact that occasionally these procedures are followed by a chill even with a definitely aseptic procedure. *The cause of this so-called "catheter fever" is always a peracute sepsis, which leads to abscess formation, in rare cases in the prostate, but usually in the cortex of the kidney.* This phenomenon is interesting evidence for the teaching, particularly advanced by the Mayo school, of the organ specificity of germs, in which the germs originating in the lower urinary tract and brought into the blood circulation through the catheterization that slightly injures the mucous membrane of the urethra repeatedly and electively settle in the parenchymatous portions of the urinary tract. Thus, we believe today that with our advanced asepsis such infections are no longer produced by alien bacteria, but by a squeezing of the normal saprophytes of the urethra into the blood circulation, so that in these cases the germs are such as are specifically adapted to the tissue of the urinary tract. The existence of these metastatic cortical abscesses has been proved both clinically and by autopsies, as such catheter infections are usually only transient, but occasionally still lead to chronic or even lethal so-called uroseptic diseases.

It is well known how dangerous the first catheterization of a bladder with much residual urine is. When, in such a case, an infection results, under certain conditions a fulminating sepsis with a rapidly fatal outcome is associated with this apparently very harmless intervention.

Usually, however, these infections run a milder course and there results a gradually ascending infection from the bladder to the higher sections of the urinary tract. This, however, never remains confined to the pelvis of the kidney, but always sooner or later attacks the parenchyma of the kidney; there results a pyelonephritis with more or less marked diminution of the renal function and chronic urosepsis. One can almost say, that the purpose of an early prostatectomy is to anticipate these severe complications of the later stages. This ascent of the infection from the bladder to the higher sections is a much discussed but still not entirely solved problem. Aside from the fact that a route of infection via the lymphatics of the ureter has been proved, we know that the prerequisite for such an ascent is an insufficiency of the ureteral musculature including the occlusive mechanism of the ureter, so that the so-called vesiculoureteral reflux occurs. We can well understand that anatomic changes of the ureteral ostium, such as are produced by tuberculosis, spinal disorders, ulcerative cystitis, operative cicatricial distortion and injuries following the passage of stones, lead to a gaping of the ureteral openings. But we are not interested here so much in these conditions, but rather in those cases in which with an anatomically intact ureteral wall the ureter loses its tonus temporarily or permanently. This occurs under anesthesia with the use of local anesthesia of the bladder mucosa with very mild infection and similar harmless conditions, so that even with a slight increase of the intravesical pressure a reflux of the urine as far up as the pelvis of the kidney occurs. The cystographic evidence of these conditions is always easily obtainable. Personally I believe that this phenomenon depends upon a constitutional weakness of the musculature of the ureter and represents the slightest grade of the previously mentioned congenital atony.

We now come to the discussion of the

pathology of the ureter, which represents a very frequent postoperative complication of many types of operations. Gynecological operations, particularly, lead to injuries of the ureter, which almost invariably cause infections of the kidney. Special attention should be called to the fact that these infections of the kidney rob the immediate surgical successful transplantations of the ureters of their permanent results, as these transplantations, even when done with the most perfect technic, can neither replace nor simulate the natural occlusive mechanism of the ureter, so that there results either a wide communication or, more often, there results a stenosis at the site of implantation from secondary cicatricial contraction with subsequent dilatation of the efferent urinary passages, urinary stasis, infection and, finally, destruction of the kidney. Occasional permanent results of such transplantations cannot disprove the knowledge of the best German gynecologists obtained from extensive statistical experience.

Among the postoperative infectious complications in the kidney, all the different operations on the pus foci in the body assume an important position. After Rovsing in 1889 and later German authors, especially, Scheidemann in 1913, called attention to the significance of tonsillitis, it is to the special credit of Rosenow, Bumpus and Meisser that they emphasized the connection between disease of the tonsils and infection of the kidney and that they considerably extended the discovery of the organ specificity of the bacteria. Here, where the postoperative connections interest us chiefly, attention must be called to the fact that such infections of the kidney result not very rarely during the operation on these pus foci, either because a protective pyogenic membrane is ruptured by the operation (especially with osteomyelitis), or the bacteria are squeezed into the opened lymph spaces, as happens particularly with tonsillectomy by squeezing and pres-

sure. A not so very inconsiderable number of the acute septic fatalities after such operations have a peracute hematogenic diffuse pyelonephritis as an anatomic substrate.

Finally, the intestine is of the greatest practical importance as a source of the development of infections of the kidney. And as evidence of the importance that we attach to these factors, it should be said from the very beginning that the relative frequency of infections of the kidney in women should not be attributed to the short length of the female urethra, but rather to the relative frequency of the disturbances of motility of the intestines in females. The reports in the literature on the connections observed between infection of the kidney and disturbances in the activity of the gut (especially obstipation) vary considerably. A probable explanation for these differences of opinion might be the following: here, exactly as in the pelvis of the kidney, even a diminution of the motility with such a slight functional disturbance that it is not recognized by the patient, is sufficient and therefore escapes a superficial examination on the part of the physician. Colitis, appendicitis, cholecystitis, and even slight gastrointestinal disturbances lead to obstinate infections of the kidney in spite of all forms of therapy, which rapidly lead to recovery after removal or successful treatment of the primarily diseased portion of the gut.

This relationship between the gut and the urinary tract as a postoperative complication, which is so constant, that the French urologist Heitz-Boyer speaks of an "entero-renal symptoms complex," may become effective when long-continued disturbances of intestinal activity exist in a more or less immediate association with the operation. In this connection, one must also think of the effect of an intervention on the part of the physician which, though not immediately surgical, is very consequential in connection with operations, namely, the use of morphine. There is hardly another therapeutic remedy that exerts

such an unfavorable effect upon all the function of the urinary tract and, among others, in the sense of a predisposition to infections: it paralyzes the secretion of the kidneys, produces hypertonia of the sphincteric musculature of the ureter and the bladder sphincter through its spastic components, and makes possible an exodus of bacteria as a result of paralysis of the musculature of the intestine. We believe today that the large majority of all postoperative retentions of urine in the bladder are produced not by the operation on the organs adjacent to the bladder, but by the preoperative and postoperative use of morphine. Very many surgical clinics have, therefore, entirely given up the use of morphine and limit themselves to substitution products. The German chemical industry, however, is endeavoring to remove this spasm-producing radical from the morphine molecule.

When we attempt to draw the therapeutic conclusions from these considerations of the pathology of the infections of the kidney, the first principle established is, that a severe disease of the kidney

may develop under unfavorable conditions from even the most harmless appearing postoperative bacilluria or mild pyuria. Among these unfavorable conditions a motor insufficiency of the efferent urinary passages following many very different types of operation assumes the first place. Inasmuch as this stasis can be determined and treated only by catheterization of the ureters, a careful urological examination in all such cases is the most important requisite of medical knowledge and the physician's duty. It is worthy of mention, that in some cases even the drainage of the bladder by a simple catheter accomplishes also drainage of the kidney. On the other hand, pyelonephritis is still to a great extent outside the pale of our therapeutic ability, as we know little of the predisposing factors of its development. In this case, the therapy is limited to the intensive use of intravenous injections of urotropine. According to our view, a careful control of intestinal motility occupies the center of the stage in all prevention and therapy of colon bacillus infections of the urinary tract.



# POSTOPERATIVE EVENTRATION\*

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COMPLETE wound breakdown with an escape of part of the abdominal contents is a postoperative complication that happens without apparent rhyme or reason. No operator who does any amount of abdominal surgery will go for long periods of time without having it happen to a patient.

In a search through the literature very little has been found written on the subject. There is no unanimity of opinion as to the causative factors. It has been claimed that sepsis, hemorrhage into the peritoneum, faulty ligatures, poor approximation of the wound edges, excessive postoperative coughing with suture breaking, and syphilis lead to this condition.

Except for a persistent slight elevation of temperature, never more than two degrees one has no warning eventration will occur. When the wound sutures or clips are removed, the skin seems as far as inspection goes, healed by primary union. There is no bulging. The wound looks healthy. Dressings are applied and, as a rule, all thought of the wound is dismissed from the operator's mind.

About two or three days later the operator's house-man or nurse telephones him that the patient's wound has opened and intestines and omentum are spread over the abdomen. The patient may be in mild shock. Often the patient has suffered no sensation of moment.

When observed the wound edges seem dry and necrotic. There is no evidence of hemorrhage. Pus is absent.

As soon as the diagnosis of eventration has been made the attendant, interne or nurse covers the eviscerated contents with sterile gauze wet with warm boric acid

solution. The patient is given grains  $\frac{1}{4}$  of morphine sulphate. The operating-room is made ready.

The technic we offer for correcting this complication is not original.

The wound edges are freshened by rubbing them with sterile gauze sponges. The abdominal contents are returned within the abdominal cavity. Two strips of 2 to 4 in. iodoform gauze, each strip from 4 to 6 in. long, are sutured end to end with one interrupted plain catgut suture. This sutured end to end gauze is placed over the intestinal contents presenting through the wound, the ends protruding beyond the upper and lower wound angles. The wound is closed over this gauze using interrupted silkworm sutures. Each suture takes in every layer of the abdominal wall. It is poor practice to attempt closure in layers.

About the tenth day after resuturing, the gauze strip is removed. The plain catgut suture has been absorbed and by pulling on the end protruding from each angle of the wound the gauze comes away in two pieces. About five days later the silkworm sutures are removed.

After the resuturing, the patient is left flat in bed. A Harris or Murphy drip is instituted and continued for three or four days. Small doses of morphine are given for the first forty-eight hours.

As a rule the convalescence is uneventful. We have seen or heard of no second eventration following the closure we have outlined.

The writer has had five postoperative eventrations. All 5 cases were treated by this technic. All wounds subsequently healed. There were no fatalities.

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# DANGERS IN THE USE OF HYPERTONIC SOLUTIONS IN THE TREATMENT OF BRAIN INJURIES\*

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SINCE Weed and McKibbin<sup>1</sup> reported the changes in brain volume, intracranial pressure, blood pressure and respiration following the intravenous injection of

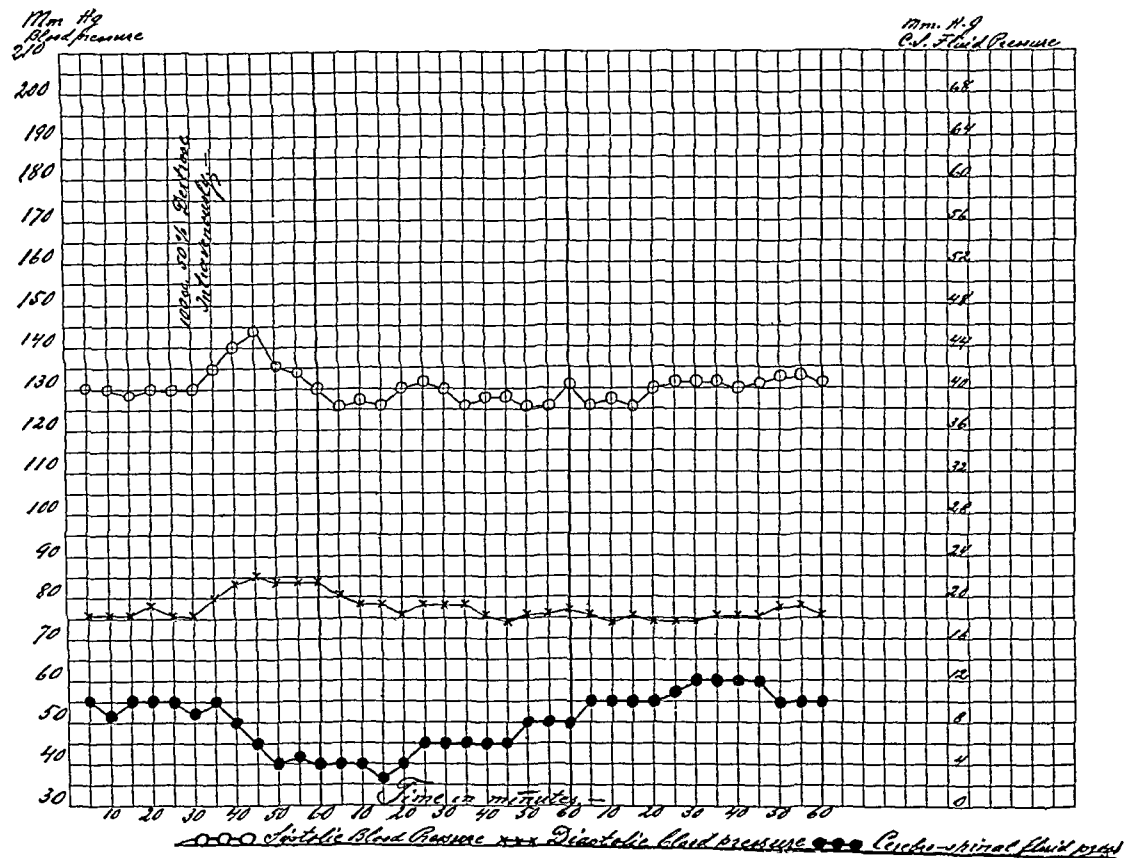


FIG. 1. Average curves, blood pressure and cerebrospinal fluid pressure of 4 normal individuals following intravenous injection of 100 c.c. of 50 per cent glucose.

the intravenous injection of hypertonic solutions, many clinical applications of this phenomena have been devised. Foley and Putnam<sup>2</sup> reported their experimental observations following the intravenous, oral, rectal and intraduodenal administration of 25 per cent sodium chloride solution. In each instance a distinct fall of cerebrospinal fluid pressure was noted. Comparing the results obtained from the intravenous method and the gastrointestinal route of administration, they found that the extent of the fall in the 2 cases was approximately equal. Sachs and Malone<sup>3</sup> investigated

25 per cent saline solution, using dogs as the experimental animal. They concluded that the method was a valuable aid in reducing brain volume in cases of increased intracranial pressure.

Foley<sup>4</sup> in a later communication reported his observations in the human subject, measuring the changes in the cranial pressure by the tension of a bulging decompression opening. Both the intravenous and oral methods of administration were used, the fall in the cerebrospinal fluid pressure being approximately the same in the 2 instances. He also calls

\* Submitted for publication, April 2, 1930.



attention to the fact that there may be medullary depressant effects during or immediately following the intravenous

25 per cent saline solution the present study was undertaken.

Different concentrations of both glucose

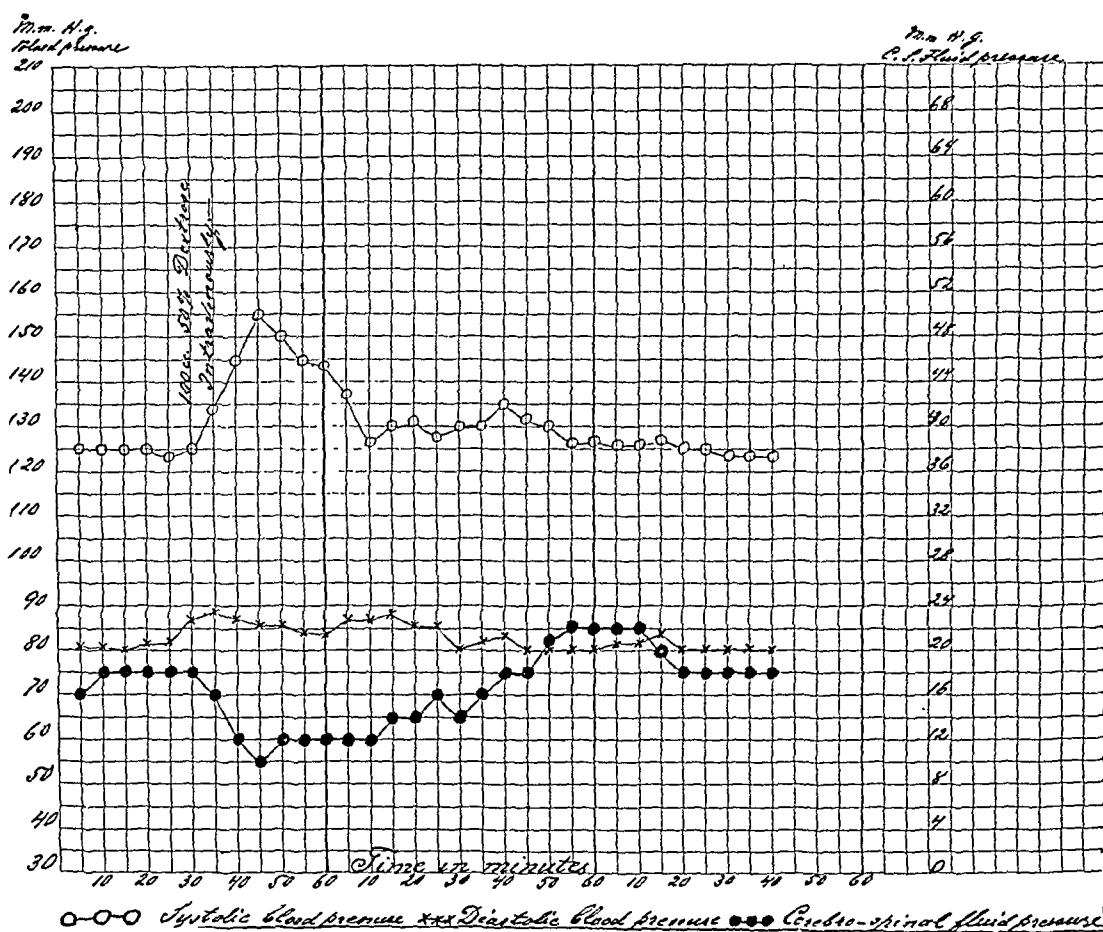


FIG. 2. Average curves, blood pressure and cerebrospinal fluid pressure of 5 patients, type 1 reaction.

injection of hypertonic solutions, which was not observed when the gastrointestinal route was used.

From the time of these publications, the methods of treating increased intracranial pressure due to brain hemorrhage and edema associated with trauma to the head began to change from the time-honored sub-temporal decompression or repeated spinal drainage to the intravenous and rectal injections of hypertonic solutions.

That great damage may be done by the routine use of so powerful a dehydrating agent as 25 per cent sodium chloride or 50 per cent glucose solution has been amply shown by the present clinical investigation.

Because of a fatal outcome following the intravenous injection of 60 c.c. of a

and saline solutions have been used, but it has been found by clinical experience that 50 per cent glucose in 75 c.c. to 100 c.c. doses produces the desired effect and causes fewer untoward reactions. Because of this fact glucose in such concentration was used in these experiments.

**Subjects:** All patients were adult males. Four with traumatic lesions of the extremities were used as controls. In each, the reduction of the cerebrospinal fluid pressure was about the same. The average of the 4 (Fig. 1) has been charted.

Thirteen patients admitted to the hospital because of injury to the head were studied. Four of these observations were not completed because of restlessness of the patients. Of the remaining 9, 8 had been in the hospital for periods ranging

from six to ten hours. These were unconscious or stuporous, but quiet and would remain in any position placed. The ninth

five to thirty minutes before the intravenous injection of the 50 per cent glucose solution was begun. Readings were taken

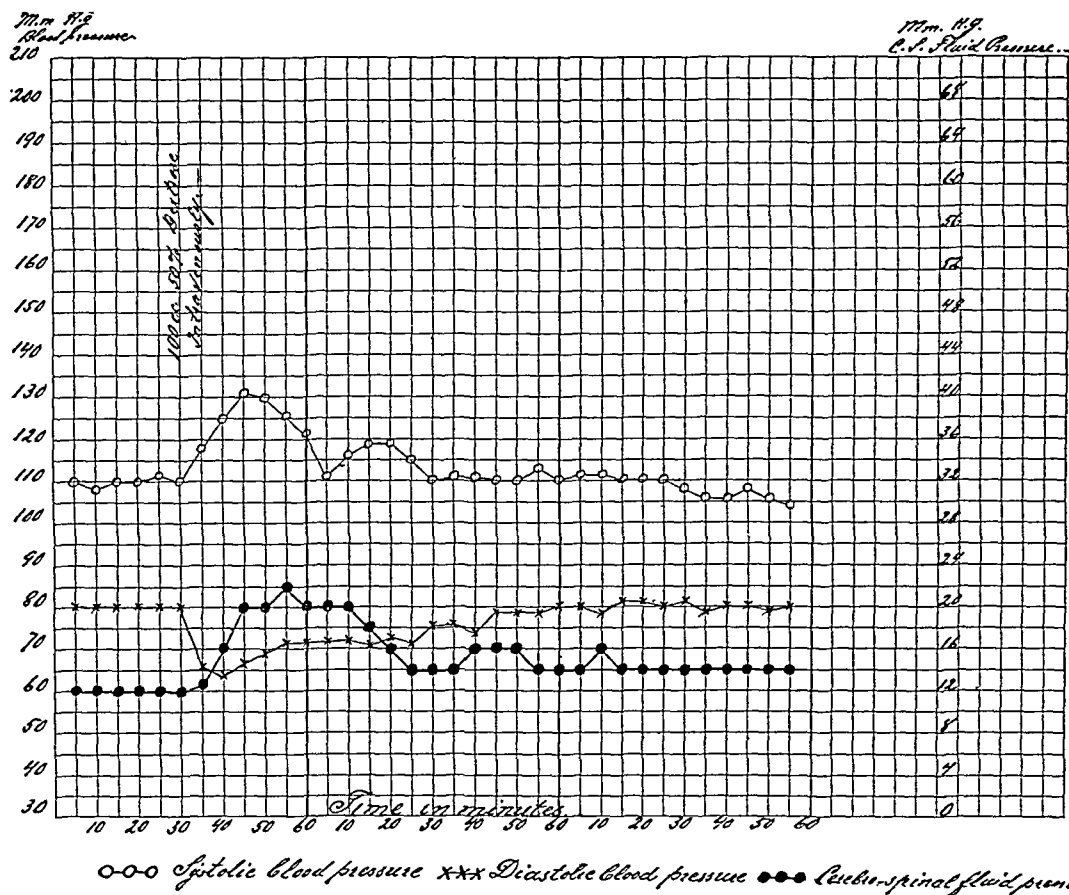


FIG. 3. Average curves, blood pressure and cerebrospinal fluid pressure of 3 patients, type II reaction.

was in deep coma, bleeding from nose and right ear, absent reflexes and fluid obtained from lumbar subarachnoid space had the appearance of venous blood.

**Technic:** Throughout the period of observation the patient was kept on the right side with lower extremities flexed, spine flexed and head placed on a pillow in normal relation to the trunk. A large bore spinal-puncture needle was introduced into the lumbar subarachnoid space and attached to a mercury manometer without loss of cerebrospinal fluid. The same size and length connecting tubing was used in each case. A sphygmomanometer cuff was attached to the left arm and diaphragm of a stethoscope fixed in left antecubital fossa. Blood pressure, pulse and cerebrospinal fluid pressure readings were taken every five minutes for twenty-

every five minutes for a variable period following the injection, the average being two hours and fifty minutes.

**Results:** In this small group of patients there were 3 distinct types of reactions.

In type I group, there were 5 patients who had a moderate decrease in their cerebrospinal fluid pressure associated with slight rise of blood pressure and pulse rate immediately after injection of the hypertonic solution (Fig. 2). There was also improvement of their mental state as evidenced by attempted motor activity and general appearance. None of these regained consciousness, although the cerebrospinal fluid pressure as measured at its lowest point was below the accepted normal. In all the cerebrospinal fluid was pinkish tinted with red blood cells.

In type II group, there were 3 patients

whose cerebrospinal fluid pressure showed a distinct rise following the injection of the hypertonic solution. This was asso-

clearly by the chart, the blood pressure began to fall. This was associated with an extremely rapid pulse, rapid labored

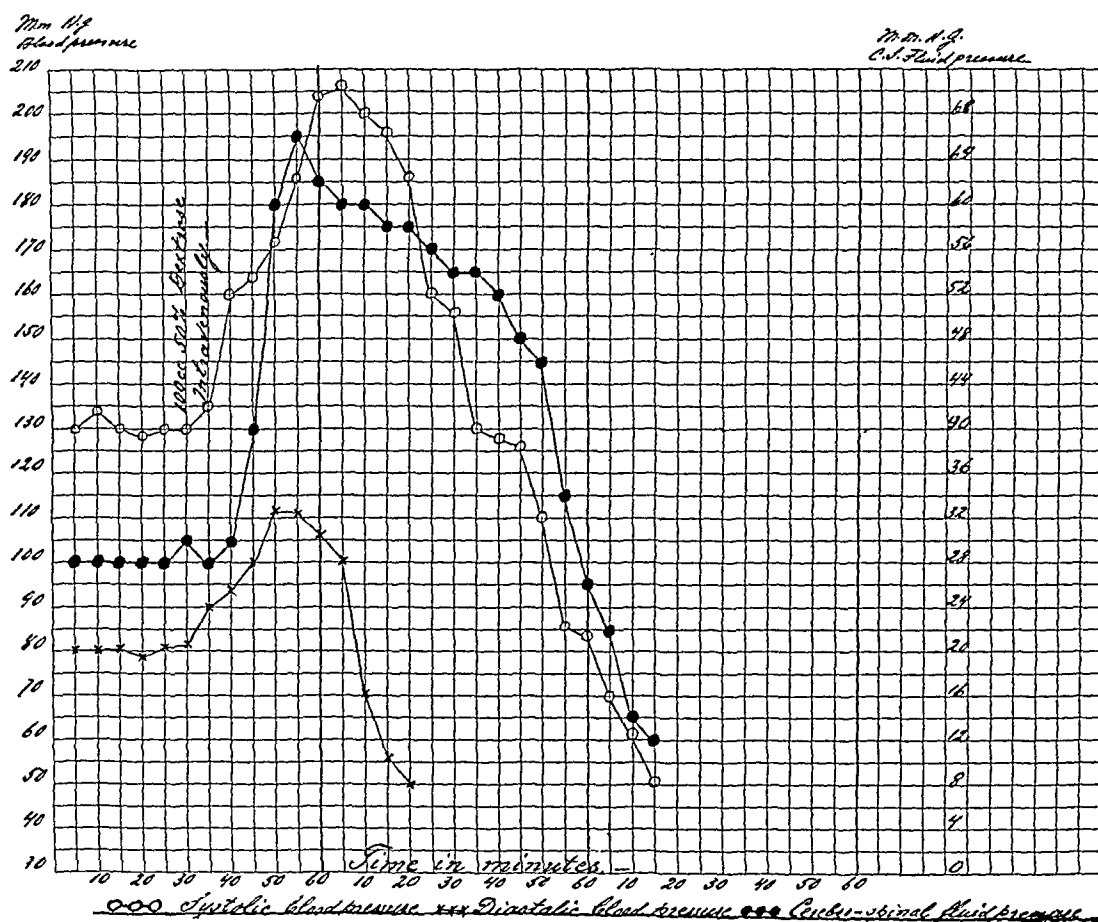


FIG. 4. Curves, blood pressure and cerebrospinal fluid pressure of 1 patient, type III reaction.

ciated with a rise of blood pressure and pulse rate (Fig. 3). The only change noted in their general condition were slight cyanosis of the skin and mucous membrane and increase in the thoracic respiratory excursion. This disappeared after a period of ten to fifteen minutes. These 3 subjects were thought to have severe brain injury. In each the cerebrospinal fluid contained blood in sufficient quantities to produce a cherry red color.

In type III group, there was 1 patient whose condition has already been briefly described. Almost immediately following the administration of the hypertonic solution there was a marked rise of blood pressure, cerebrospinal fluid pressure, and pulse rate (Fig. 4). The respirations were also accelerated, labored and irregular. After thirty-five minutes as indicated

respirations and cyanosis. Death occurred one hour and fifty minutes following the injection of the hypertonic solution. At autopsy there was found lacerations of the under surfaces of the frontal lobes with large amount of subarachnoid hemorrhage (Fig. 5).

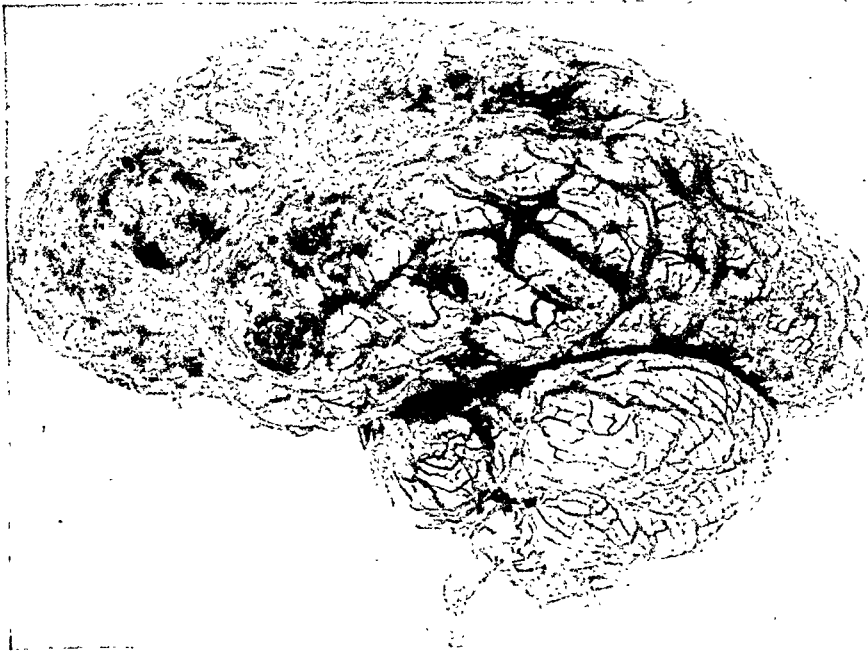
#### DISCUSSION

It would be impossible to draw any conclusions from such a group of cases, but for the fact that the author feels that they are representative of a group of head injuries in a large hospital where about 400 such patients are admitted annually. Many of these are in deep coma when admitted and die within a very short time regardless of what is done for them. Others seriously injured react after one to three hours, but die from twenty-four to

forty-eight hours regardless of what type of therapy is instituted.

These 2 loosely classified groups make

increased cerebrospinal fluid pressure due to intracranial lesions without a recent break in the cerebral vascular system



[FIG. 5. Photograph of brain of patient showing type III reaction. Note extensive subarachnoid hemorrhage.

up 18 per cent of the total number in 946 consecutive admissions. That increased intracranial pressure alone is not the only factor causing death can be demonstrated in most instances by repeated manometric readings. Often one finds the spinal or cisternal subarachnoid pressure only slightly above the accepted normal when at autopsy extensive cerebral laceration or contusion is present. From clinical and pathological observations it would seem that the terminal factor is intercellular and intracellular edema, particularly of the medulla.

With this pathological picture in mind the logical attempt at therapy would be to change the osmotic pressure of the blood by injecting hypertonic solutions thereby causing a decrease in brain tissue edema. A transitory improvement following such a procedure has been observed in many instances whereas harmful and even fatal results have occurred in others. It must be kept in mind that reducing

is quite a different problem from that due to hemorrhage and edema following trauma. In the former such as tumor, edema surrounding a tumor or edema secondary to trauma without evidence of hemorrhage, hypertonic solutions may be given with a certain degree of safety. In the latter instance where there are findings pointing toward recent blood vessel injury with subarachnoid hemorrhage, one should be very cautious about changing the osmotic pressure of the blood.

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## ALKALOSIS\*

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IN presenting this paper it is our intention to discuss the early diagnosis and treatment of alkalosis, to emphasize the importance of early diagnosis, and to review a portion of the voluminous literature that has appeared on the subject during the last few years.

The term alkalosis covers a definite clinical picture which may be found in cases that are undergoing medical treatment as well as in postoperative cases. The terms acute paralytic ileus, acute gastric dilatation, gastric tetany and acidosis have been used in the past to denote the syndrome found in this condition.

The condition may occur in cases of intestinal obstruction, the severity varying with the acuteness and location of the obstruction; in cases of peptic ulcer where the patient has been receiving alkaline treatment; and as a postoperative complication following general anesthesia, and to a lesser degree, local and spinal anesthesia.

The patient is mentally alert and apparently unaware of the seriousness of his condition. However, he looks acutely ill, with cheeks sunken and eyes bright. He is apt to talk on trivialities. His skin is cold with beads of perspiration standing out on his forehead. As the disease progresses he shows fibrillary twitching of the hands and feet. The extremities are cold and clammy and the lips and nail beds are often cyanotic. The patient passes into a deep coma preceding death. Vomiting is an early and constant symptom, the vomitus being at first gastric and duodenal contents, and later being fecal in character, light brown in color and of foul odor. Vomiting at first is accompanied by retching but later becomes passive, apparently spilling from the patient's mouth. Hic-cough is a frequent symptom, often being one of the first to develop. In the early stages the patient may pass gas and feces

but soon there is complete cessation of intestinal movement with tympanites. The temperature is normal or subnormal with an antemortem rise. The pulse is weak and rapid from the start and the blood pressure is persistently low. The respirations are shallow and rapid. In short, the clinical picture is that of shock plus intestinal obstruction.

The red blood count is normal, becoming increased later due to dehydration from persistent vomiting. There is a leukopenia. The urine is usually scanty and on examination shows a trace of albumin and a few casts. The non-protein nitrogen in the twenty-four-hour specimen is markedly increased, often as much as 4 or 5 times the normal amount. The urinary chlorides are greatly reduced. Kidney function, as shown by dye excretion, is normal or slightly decreased.

The blood chemistry is characteristic and the most important of the diagnostic points. There is a constant increase in the non-protein nitrogen, a marked decrease in the chlorides and an increase in the  $\text{CO}_2$  combining power of the blood.

The pathological findings are not diagnostic. The chief feature is a marked splanchnic engorgement. In the absence of obstruction the intestine is distended with fluid and gas. If an obstruction is present the intestine, if not ruptured, is much distended above the site of obstruction. The intestinal wall is dusky red and may present areas of gangrene. The lumen is full of foul smelling reddish brown fluid teeming with bacteria. The mucosa is deeply injected and presents ulcerations. Histologically the intestinal wall presents marked capillary engorgement and areas of necrosis. Some have described fatty changes in the liver and evidence of toxic nephritis.

The two outstanding features are:

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1. The intense toxemia.

2. The marked dehydration accompanied by a constant blood chemistry, consisting of a rise in non-protein nitrogen, a fall in the blood chlorides, and an increase in the  $\text{CO}_2$  combining power.

For years numerous investigators have been studying this toxemia and although there is not complete agreement on the subject, the consensus of opinion appears to be that the causative toxin is found in the intestinal content above the obstructive point. The higher the point of obstruction, that is, the nearer it approaches the ampulla of Vater, the more severe is the clinical picture, and the more rapidly the case progresses to fatal termination. It has been shown that the contents from the intestines in obstruction, or from an obstructed intestinal loop, if injected into a laboratory animal, will produce the identical picture of toxemia with death in a few hours. Furthermore, if a dog with a duodenal fistula is given an injection of either the intestinal contents from an obstructed loop, or the intestinal contents from a dog which has been injected with the contents of an obstructed loop, this toxin will be recovered from the duodenal fistula within two hours after the injection, and will be equally as toxic to another animal as were either the contents from the obstructed loop or from the second dog injected. This process can be repeated indefinitely. Cooper,<sup>1</sup> after a most exhaustive study of the literature pointed out the following facts concerning the properties of this toxin:

1. It is held back by an earthen filter but not by paper.

2. It does not pass a semipermeable membrane.

3. It is not destroyed by boiling.

4. It is not destroyed by long digestion with pancreatic juices (seven days).

5. It is not destroyed by autolysis with intestinal mucosa (for months).

6. It is not destroyed by erepsin.

7. It is probably destroyed by hydroly-

sis with 5 per cent sulphuric acid for six hours at  $100^\circ\text{C}$ .

8. Repeated precipitation removes its toxicity.

9. It loses its toxicity if dialyzed against physiologic sodium chloride for several hours.

10. It loses its toxicity by repeated filtrations.

11. It loses its toxicity by long standing at freezing temperatures.

12. It is soluble in water.

13. It is precipitated by 5 volumes of alcohol.

14. It is precipitated by albumin.

15. It is precipitated by 60 per cent ammonium sulphate solution.

16. It does not stimulate pancreatic digestion.

Although the toxin has been demonstrated in the contents of the intestine, the origin of the toxin is in doubt. In obstructed loops the toxin has been demonstrated to be both in the blood and lymph draining from the loop. However, the blood of an animal with marked toxemia from obstruction is non-toxic to another animal even though the entire blood is transfused.

In obstruction in the newborn or in sterile closed loops in experimental animals, this toxin is apparently absent, which fact would seem to point to a bacterial origin. Against this, however, is the fact that the higher the obstruction the more severe the toxemia, while the bacterial count is comparatively low in the upper intestines as compared to that in the colon. If the toxemia is bacterial in origin, obstruction of the large intestine should therefore be much more severe than that of the duodenum, which we all know is not the case. Moreover, death from a toxemia apparently identical with that in obstruction is seen in acute strangulation, in complete extirpation of the suprarenals, in bilateral ligation of the ureters, thrombosis of the portal vein and distemper.

What is the origin of this toxin? Experimental work has rather conclusively ruled out the stomach as a source. Elimination

of the bile does not alter the picture. The pancreas cannot be a factor as the same picture is presented in depancreatized dogs. There is much difference of opinion as to whether the secretion of the intestinal mucosa may be the causative factor. There are also many varied opinions as to the part bacteria play, and those who favor it must explain:

1. Why is high obstruction more rapidly fatal than low obstruction?

2. Why does toxin appear with such rapidity (within three hours) after obstruction?

3. Why does toxin appear almost immediately in the intestines of dogs that have received injections of it?

4. Why does the toxin appear in acute pancreatitis, thrombosis of the portal vein, bilateral suprarenalectomy, bilateral ligation of the ureters, and distemper?

Some think that the toxin may arise from partly digested food and that the toxin is derived from protein digestion. The majority of observers think that the toxin is absorbed through the injured gut mucosa.

We shall consider the second outstanding feature of this condition namely, dehydration and blood picture.

Neither the dehydration nor the altered blood chemistry can be considered as cause of death, since death occurs in strangulation and in the other conditions enumerated above without dehydration or a change in the blood chemistry. The dehydration is a result of the persistent vomiting and is directly proportional to it. Also the decrease in the blood chlorides is directly proportional to the vomiting. The loss of the Cl or acid radical causes a disturbance in the acid-base balance with a resulting alkalosis. As a result of the loss of Cl the excess sodium radical is taken up by the acid phosphates of the tissues instead of being neutralized by the Cl from the intestinal tract to form NaCl.

Hence the decrease of blood chlorides is directly proportional to the loss of Cl

by vomiting. As a result of the loss of the acid radical Cl, there is a rise in the carbonic acid radical of the blood, this being a natural attempt of the body to maintain acidity of the blood at its proper level. The increase in the CO<sub>2</sub> combining power of the blood varies inversely as the decrease in the blood chlorides and is also directly indicative of the degree of alkalosis.

The rise in non-protein nitrogen is the result of tissue metabolism with destruction of the proteids. It cannot be explained by dehydration since it has been repeatedly shown that the increase in the urea is relatively many times greater than the degree of dehydration. Further, it cannot be explained by retention, since the kidney function is normal and the urinary output is normal or only slightly decreased. The cause of this proteid destruction is unknown. However, the increase in the non-protein nitrogen in the blood is directly proportional to the decrease in the blood chlorides and to the increase in the CO<sub>2</sub> combining power, and all three respond correspondingly to the same line of treatment.

So much for the toxemia and dehydration, but what has happened to the unobstructed bowel that fails to transport fluids and gas? Alvarez and Hosoi<sup>2</sup> showed by experimental work on animals that section of the spinal cord distal to the fourth dorsal segment caused such a strong stimulus to peristalsis that after a few hours the bowel tends to empty itself with repeated rush waves. In animals with the terminal ileum injured they saw few rush waves and in some they seemed to be stopped entirely, even though the lumen of the bowel was unchanged and the rhythmic movements were active and the muscles efficient. Alvarez and Hosoi believe therefore, that we must find a new term for the type of ileus which is not due to mechanical obstruction or narrowing of the gut lumen. It is not paralytic because the muscle is active and apparently in good working order,

and it is not dynamic since there are none of the white ring-like contractions that sometimes obstruct the bowels in children. They offer the explanation that there is a flattening, or reversal, of the normal gradient of forces, and an excess of inhibition, and suggest the term flat gradient ileus for this type of condition.

#### TREATMENT

In comparison with the many and varied opinions as to the cause and origin of the toxemia in alkalosis, we find that in the treatment of the condition most observers are agreed, at least upon the essentials.

Care should be used in the administration of alkaline drugs in the treatment of peptic ulcer especially in the presence of pyloric obstruction or kidney damage.

In preoperative cases where there is intestinal stasis and no emergency exists, medical treatment consisting of repeated stomach lavages and the administration of NaCl should be carried out until the blood chemistry has been brought within normal limits.

Preoperative purgatives are to be condemned as they weaken the muscles and disturb the mechanisms that remove the gas.

Alvarez and Hosoi<sup>2</sup> demonstrated that distending and irritating enemas especially with glucose solution tended to reverse the gradients and produce more back pressure and reverse peristalsis.

As little morphine should be used as possible as in many persons it increases the tendency to reverse peristalsis. Barbitol derivatives do not upset the gradients and are probably the best substitutes we have for morphine.

Some think that ether upsets the gradients and should be replaced by other forms of anesthesia. However, we have seen several cases of alkalosis develop following both spinal and local (procaine) anesthesia.

Unnecessary and rough handling of the abdominal viscera is advised against.

As to the various drugs that are commonly in use, atropine and strychnine are unreliable and ineffective. Nicotine would be an ideal drug if it were not so highly toxic, as it blocks the passage of nervous impulses through the sympathetic ganglia. Pituitrin, when given in large doses of physiologic NaCl will stimulate peristalsis but it is as apt to do harm as good. Eserin is not reliable. Alvarez and Hosoi<sup>2</sup> state that choline is a drug that gives great promise. Von Magnus<sup>3</sup> and his pupils in their experimental work have much evidence to prove that it is a normal constituent of intestinal muscles and is concerned in some way with maintaining peristalsis. The drug must be chemically pure as it tends to break down into toxic substances. Merck and Kahlbaum supply it in ampules containing 600 mg., and put up in this manner it will keep for several years. For a man weighing 60 kg., the 600 mg. should be added to at least 250 c.c. of physiologic salt solution and run into a vein so slowly that the process will take at least seventeen minutes. If the patient complains of flushing, dyspnea, dizziness and salivation, and the pulse becomes slow, the container should be lowered. We have had no experience with this drug.

As to food some think that these patients should be fed for the purpose of stimulating peristalsis, and suggest that meat be given them as it probably has the most stimulating effect on the tone of the gastrointestinal tract. Our experience with feeding has led us to believe that it only aggravates the condition unless the toxemia and vomiting have previously been relieved by lavage and NaCl.

Much difference of opinion exists as to the value of the antitoxin of *Bacillus welchii*. Morton and Stabin,<sup>4</sup> in their experimental work found that the toxin of *B. welchii* has a bearing on intestinal obstruction and that the antitoxin appears to be specific in its action, since other forms of antitoxin are not effective. Owings and McIntosh<sup>5</sup> found that the life of dogs in high obstruction was not



prolonged by antitoxin of *B. welchii* and immunization of dogs of the toxin of *B. welchii* did not prevent a fatal outcome in those given a minimum lethal dose of loop toxin. Stabins and Kennedy<sup>6</sup> experimentally recovered the organisms of *B. welchii* from the jejunum 10 in. distal to the ligament of Treitz in 17 per cent of their series at the time of artificial obstruction at this level. After the development of toxic symptoms the organism was recovered proximal to the obstruction in 94 per cent of their animals. Williams<sup>7</sup> reports very favorably upon the use of the antitoxin at the St. Thomas's Hospital. It was administered to 18 of the most severely ill of a series of 256 consecutive cases of obstruction following acute peritonitis. There were three deaths, making a mortality rate of 1.17 per cent. A control series of 111 cases at the same hospital which were not given the *B. welchii* antitoxin showed a mortality rate of 6.3 per cent. The antitoxin was given in addition to operative relief in 54 cases of acute intestinal obstruction, and there was a mortality rate of 9.3 per cent as opposed to the rate of 24.8 per cent in a series which did not receive antitoxin. Bower and Clark<sup>8</sup> report favorably upon its use, having administered it in 9 cases of acute intestinal obstruction, 11 of diffuse suppurative peritonitis, and 5 of suppurative cholecystitis. They found their patients less restless; the pulse rate was diminished, the temperature reduced, abdominal distention became less, and bowel movements began earlier.

Bonney<sup>9</sup> in 1910, was the first to advocate drainage of the jejunum, and since that time jejunostomy has been used with rather indifferent success. Van Beuren and Smith,<sup>10</sup> in reviewing the cases of enterostomy performed in acute ileus at the Presbyterian Hospital from 1914 to 1923, and the Roosevelt Hospital from 1910 to 1919, showed a higher mortality rate in the enterostomized cases than in the entire group, but were of the opinion that enterostomy had been reserved as a last resort

in the most critical cases, and therefore had not a true bearing on the efficacy of the treatment. Dudley<sup>11</sup> states that obstruction of the paralytic type accounts for 40 per cent of the deaths following operation for acute appendicitis in the presence of diffuse peritonitis, and believes that jejunostomy is the most efficient means of combating the toxin. Orr and Haden<sup>12</sup> found enterostomy of no avail in fulminating general peritonitis. In peritonitis of the lower part of the abdomen it is life-saving and in all doubtful cases should be done. Bartlett<sup>13</sup> states that the high mortality reported following enterostomy is the inevitable concomitant of its use in patients already dying. He uses spinal anesthesia in determining when to perform an enterostomy. If within fifteen minutes after the injection of the spinal anesthetic, passage of gas and feces and disappearance of abdominal distention does not occur, enterostomy should be performed immediately, thus taking advantage of the anesthesia already produced. Longer delay permits progressive depletion of the NaCl and water reserves, interference with circulation of the gut, absorption of toxins from the intestines, and advancement of those other processes which singly or in combination cause death.

Spinal anesthesia in the treatment of intestinal obstruction has many proponents. Greig<sup>14</sup> reported favorably on its use in 400 cases. Studdiford<sup>15</sup> especially recommends it in dynamic ileus but also uses it in all types of obstruction to be followed by operation if necessary. Markowitz and Campbell<sup>16</sup> have used spinal anesthesia in the laboratory on dogs after producing ileus by chemical or traumatic means, and have observed peristalsis carefully by means of barium meals and the fluoroscope, when they have noted that peristaltic movements commenced soon after the spinal anesthesia and persisted in some instances for over twenty hours. They offer the conception that paralytic ileus is a reflex inhibition of bowel movements. Starling<sup>17</sup> states that stimulation

of the splanchnic nerves causes complete relaxation of the intestine, while stimulation of the vagus causes increased contraction following a brief period of relaxation. He also suggests that the relaxed condition of the intestine in many abdominal conditions is probably due to reflex stimulation of the splanchnic nerves which nullifies the motor action of the vagus.

The probable explanation of the effect of spinal anesthesia in ileus is that splanchnic inhibitory reflexes are blocked so that the vagus motor reflexes have full power. It is well to keep in mind that spinal anesthesia will not be effective if the patient is under the influence of morphine.

The efficacy of the treatment of alkalosis by the use of hypertonic solution of NaCl has been proved both experimentally and by clinical use. NaCl in 2 to 25 per cent solution intravenously acts as a strong intestinal stimulant. It has been shown beyond a doubt that water alone will not influence alkalosis, and also that KCl,  $\text{NH}_4\text{Cl}$ ,  $\text{CaCl}_2$ , and  $\text{MgCl}_2$  are not only useless but increase the severity of the alkalosis. Anderson and Rockwood<sup>18</sup> reported 90 cases of low blood chlorides associated in most cases with abdominal lesions treated with hypertonic saline solution intravenously with a reduction of the operative mortality of more than one-half. Foster and Hausler<sup>19</sup> brought out the fact that loss of chlorides is apt to occur in what they call the "critical period," which corresponds with the healing period of intestinal wounds in experimental animals, and lasted four or five days after operation. They therefore suggested keeping the chlorides at their proper level for five days. This conception we think is well founded and in practice has given us excellent results. It has been our custom to give 1000 c.c. of normal saline intravenously plus 100 to 500 c.c. of 2 per cent NaCl solution and 40 to 50 gm. of glucose daily. The glucose is given in 5 per cent solution with the normal saline. This we have found controls the toxemia in the average case quite effectively.

The treatment should be checked by blood chemistry examinations whenever possible, but where such procedures are not easily available the course of the treatment may be checked by the clinical picture which improves as the chlorides approach normal. In experimentally produced general peritonitis Orr and Hayden<sup>12</sup> were able to keep animals alive 3 times as long with ileostomy plus 1 per cent NaCl as with ileostomy alone, and they state that no treatment for peritonitis should be given to the exclusion of large quantities of saline solution to relieve the dehydration and hypochloremia.

In addition to the intravenous therapy it is advisable to drain the upper intestinal tract of its toxic content, either by repeated gastric lavages or duodenal drainage. It is surprising how quickly the hiccough, the vomiting, and the clinical picture of shock subside after a few hours of duodenal drainage. However, we must keep in mind that in draining the intestinal tract we are predisposing to further dehydration and hypochloremia and must make up for it by giving saline intravenously.

If tetany develops, calcium chloride should be given in addition to the NaCl. This is administered most effectively in 5 c.c. doses of 10 per cent solution intravenously, and repeated every two hours until controlled.

Formerly the accepted treatment in cases of persistent vomiting in intestinal obstruction, postoperative ileus and allied conditions was the use of sodium bicarbonate, either intravenously or by proctoclysis, and the term acidosis was generally accepted for the clinical picture. With our present knowledge of the blood chemistry findings further attempts at alkalization are certainly contraindicated. Whatever benefits may have been observed following the use of sodium bicarbonate was probably due to the introduction of the sodium radical.

It is quite natural for a patient who has had an abdominal operation to prefer to lie quietly in bed on his back, and those

with tympanites usually insist on having the chest and head elevated. Unless there are some contraindications we believe that patients should not only be encouraged, but should be forceably moved from side to side, which will tend to shift the gas from one part of the intestines to another. Moreover, it is reasonable to expect that gas trapped at the splenic flexure might be thrown into the rectum where it could be passed, by simply elevating the hips above the mid-portion of the body.

The following cases are reported:

CASE I (33442). White, obese, male, age thirty-four years.

Admitted to hospital on December 6, 1928, with a history of having developed generalized abdominal pain four days previously which soon settled in his right lower quadrant. Temperature was 101.6, pulse 120 and respiration 18. The leukocyte count was 13,400 with 91 per cent polymorphonuclears. Urine was positive for albumin and hyaline casts. A gangrenous appendix was removed under ether anesthesia on the day of admission. On the second postoperative day he complained of belching and abdominal distention and during the night began to vomit. The stomach was lavaged and the Rehfuß tube left in place. Glucose was given intravenously and normal saline by hypodermoclysis. Strychnine sulphate and pituitrin were given repeatedly without any appreciable results. On the fourth postoperative day a bronchopneumonic patch was found at the right base. Glucose intravenously, normal saline by hypodermoclysis and proctoclysis were continued daily, and the first bowel movement was secured on the seventh postoperative day. Convalescence from there on was uneventful except for a colon bacillus infection of the abdominal wall. Had hypertonic saline been given intravenously instead of normal saline by hypodermoclysis recovery undoubtedly would have been much more rapid. Blood chemistry examinations were not done in this case.

CASE II (32892). White, male, fifty-five years of age, was admitted on October 30, 1928, with a diagnosis of recurrent left inguinal hernia and old fracture deformity of left clavicle. Urine was reported as albumin positive 1 plus and hyaline casts 1 plus. Repair

of left inguinal hernia was done on December 19, 1928. Thirty-six hours after operation complained of distention, was nauseated and vomited a small amount of greenish material. Gained some relief from an enema and rectal tube. Was given 1000 c.c. of normal saline intravenously. Vomited large amounts of greenish fluid on the following day and duodenal drainage was instituted and 1500 c.c. of normal saline given intravenously. On December 23, four days after operation, blood chemistry showed non-protein nitrogen 28 (mg. per 100 c.c.) and chlorides 363, (mg. per 100 c.c.) and he was given 1000 c.c. of normal saline intravenously. On the following day vomiting ceased and bowels moved well. On December 25 he again complained of marked abdominal distention and was given 1500 c.c. of normal saline and on the following day the blood chemistry showed non-protein nitrogen 18.9 (mg. per 100 c.c.) chloride 400 (mg. per 100 c.c.) and CO<sub>2</sub> combining power 53 (volumes per cent). On this date he was given 100 c.c. of 2 per cent NaCl and 500 c.c. of normal saline after which distention disappeared, flatus was passed and patient went on to an uneventful recovery. Strychnine, atropine, physostigmine, pituitrin and numerous enemas were given during the several days without any appreciable improvement. This case is cited to show that sufficient NaCl was not given early to control the toxemia.

CASE III (4415). White, male, forty-three years of age, entered the hospital for treatment of a right inguinal hernia of one year's duration. Physical examination was negative except for a moderate sized right inguinal hernia and a markedly relaxed ring with strong impulse on the left side. The urine showed 1 plus hyaline casts but otherwise was negative. The patient had had some trouble with his appendix previously and requested that it be removed at the same time that his hernias were repaired. Both hernias were repaired under procaine anesthesia on October 2, 1929 and the appendix removed through the right hernia incision, the three operations requiring one hour and twenty-five minutes. On the morning following operation the patient complained of considerable distention. He had been given three hypodermics of morphine sulphate gr.  $\frac{1}{4}$  for pain in the preceding twenty-four hours. Early in the second postoperative day he suddenly went into a state of shock and vomited a large

amount of dark brown fluid. He was placed between blankets and artificial heat was applied. The stomach was lavaged and the patient given saline and glucose intravenously, after which he reacted well. On the third postoperative day the patient was still considerably distended and had hiccough. Blood chlorides were 445 (mg. per 100 c.c.); saline and glucose were given intravenously. Condition was worse on the fourth postoperative day and the blood chemistry showed nonprotein nitrogen 28 (mg. per 100 c.c.) chlorides 429 (mg. per 100 c.c.) and  $\text{CO}_2$  combining power 44 (vol. per cent). A jejunostomy was performed under procaine anesthesia with the release of a large amount of gas and foul smelling fluid. On the fifth postoperative day he was not improved and the jejunostomy tube was draining very little. Saline and glucose were repeated intravenously. On the sixth postoperative day there was marked dyspnea; temperature, pulse and respiration were markedly elevated. He passed a little gas per rectum and about 1500 c.c. of fluid fecal matter through the jejunal tube. The blood chemistry at this time showed non-protein in nitrogen 28 (mg. per 100 c.c.) chlorides 445 (mg. per 100 c.c.) and  $\text{CO}_2$  combining power 48 (vol. per cent). Glucose and saline were given intravenously and a cecostomy performed under procaine anesthesia as a last resort. The patient went into coma and died a few hours later. The autopsy findings were: Postoperative atelectasis, both lungs; chronic adhesive pleurisy; hypostatic bronchopneumonia; pulmonary edema; myocardial degeneration; cardiac dilatation; postoperative paralytic ileus, degeneration of the parenchymatous organs; adenoma of the prostate; and passive congestion of the viscera.

CASE IV (31404). White, male, age thirty years. Has a history of "stomach trouble" for past six years; appendix was removed in 1923. He has had several courses of Sippy diet. Had an attack of hematemesis and tarry stools one year ago, since which time he has been very weak. While on Sippy diet under observation in the hospital on July 21, 1928, he developed tetany which was controlled by normal saline and glucose intravenously, and calcium lactate grains x by mouth every hour. Gastric resection for obstructing pyloric ulcer was performed on August 8, 1928, from which the patient with the aid of glucose and saline intravenously made an uneventful recovery.

CASE V (33744). White, male, age thirty-one years, admitted to hospital with a history of pain in right chest of one month's duration. X-ray showed a dense shadow in the axillary portion of the right lung field whose convex border, together with evidence of pleural thickening in the adjacent costophrenic sinus, was suggestive of an old encapsulated pleural exudate. The adjacent lung markings suggested atelectasis. Patient had an occasional chill, and temperature was of the septic type, ranging from 100 to 104°F. Thoracotomy was performed on January 8, 1929, which revealed a trabeculated cavity filled with blood clots. Drainage was blood tinged for several days, gradually becoming purulent. Temperature continued to be of the septic type and fourteen days after operation he developed hiccough and vomited. Hiccough continued more or less continuously for five days and the patient became delirious. At this time the blood chemistry showed non-protein nitrogen 28 (mg. per 100 c.c.) and chlorides 346 (mg. per 100 c.c.). He was given 250 c.c. of normal saline and 200 c.c. of 2 per cent saline intravenously which was repeated on the following day, after which his symptoms rapidly disappeared and convalescence was uneventful from then on.

CASE VI (4121). White, male, age thirty-one years. Gives a history of typical gall bladder colic over a period of ten years. A chronically diseased gall bladder with a stone 1 cm. in diameter blocking the cystic duct, and the appendix were removed under spinal anesthesia on November 7, 1929. Twenty-four hours after operation patient vomited a large amount of brownish fluid. Blood chemistry showed non-protein nitrogen 15 (mg. per 100 c.c.) and chlorides 470 (mg. per 100 c.c.). Stomach was lavaged and hypertonic saline and glucose given intravenously with relief of all symptoms and an easy convalescence from then on.

CASE VII (5334). White, male, thirty-six years of age. Appendectomy with exploration was performed under spinal anesthesia on November 26, 1929. Twenty-four hours after operation patient was comfortable except for some gaseous distention which was relieved by an enema. Forty-eight hours after operation he began to hiccough, became distended, and vomited large amounts of greenish fluid. Blood chemistry showed urea nitrogen 22.5 (mg. per

100 c.c.) chlorides 429 (mg. per 100 c.c.) and plasma CO<sub>2</sub> 51 (volumes per cent). After gastric lavage and hypertonic saline and glucose intravenously patient passed flatus freely and the abdomen became soft.

In conclusion we wish to make a plea for the early recognition of the toxemia associated with paralytic ileus. Those who have to do with the post-operative care

of patients should be on the lookout for the early signs that precede the characteristic changes in the blood chemistry. These are usually: a feeling of fullness in the epigastrium, belching, heartburn, hic-cough, a craving for water, and a decrease in the urinary output. It is at this stage that treatment terminates so happily, both for the patient and the surgeon.

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# CEMENT-STARCH MIXTURES AS A SUBSTITUTE FOR PLASTER OF PARIS IN THE TROPICS\*

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PUERTO ARMUELLES, PANAMA

## DETERIORATION OF PLASTER IN THE TROPICS

**S**URGEONS working in tropical countries where the humidity is high often witness the rapid deterioration of unused plaster of Paris, resulting from absorption of moisture. This is particularly noticeable when the contents of 5 or 10 lb. containers are only partly consumed, as often happens when the use of plaster is not a daily or even a weekly occurrence.

In these circumstances, it is often found that the plaster has lost its smooth amorphous character and it becomes coarsely lumpy or mixed with hard, irregular granules. This deterioration is sometimes not apparent until the bandages are applied, when it is observed that the solid portions of the plaster remain dry and unaffected by immersion; the layers of bandage fail to cohere, and the resulting cast readily bends or cracks. Some grades of plaster appear to undergo this important change without exposure and as a result of aging alone, as the alteration may be seen in plaster taken from freshly opened containers which have been hermetically sealed. There is evidence, therefore, that such aging of hermetically sealed plaster takes place more rapidly in tropical localities than in climates where there is less moisture in the atmosphere.

## SPECIAL METHODS ADOPTED IN USING PLASTER OF PARIS

To overcome these difficulties the following rules are commonly observed in the tropics: (1) Coarsely deteriorated plaster is discarded. (2) Doubtful plaster is used very liberally in rolling bandages, and about 50 per cent more is applied than in temperate climates. (3) Standard gauze bandage is used instead of crinolin or other wide-meshed material, in order to hold the increased plaster content. (4) Additional

plaster is liberally applied during the application of a cast. (5) Reinforcements of metal or wood are frequently placed at points of stress, particularly in a hip cast. To assure drying, water at 110°-120°F. is employed in the bandage basin and a half teaspoonful of salt is added to it.

## VARIETIES OF PLASTER OF PARIS

Certain French preparations of plaster marketed in 500-gm. sealed tins are entirely free of the objections mentioned. These products are of the finest quality and possess an added advantage in being packed in comparatively small containers. Best grade French plaster of Paris, however, is not always obtainable; and, moreover, in some countries a high import duty prohibits the economic use of this product.

## SUBSTITUTE FOR PLASTER

A common indication of the necessity for providing a plaster substitute is the discovery that all of the plaster on hand has deteriorated to a degree which makes its effectiveness doubtful. This experience has probably been the lot of most surgeons working in isolated localities in the tropics where quick access to a supply of fresh plaster is not always available. When such an emergency situation is encountered, fixation by splinting or extension is not always a satisfactory alternative. The writer has found that mixtures of Portland cement with starch, with certain reservations, fulfill the requirements for an emergency or semi-permanent substitute for plaster of Paris.<sup>1</sup>

## THE CEMENT-STARCH CAST

For most purposes, a mixture of equal parts by volume of Portland cement and

<sup>1</sup> Ryerson, E. W. The celluloid cast described by Ryerson is expensive and requires several days to complete. *J. Bone & Joint Surg.*, 8: 517-518, 1926.

\* Submitted for publication, April 15, 1930.

laundry starch will prove satisfactory. These materials are freshly mixed, triturated if lumpy, spread thickly on a gauze



FIG. 1. Cement-starch cast used for fixation and extension in fracture. Dislocation of third and fourth cervical vertebrae. When removed one month after application, this cast was in good condition. Composition: Cement 1 part; starch 2 parts.

bandage, rubbed smooth and loosely rolled. The bandages are placed in warm water (salt is omitted), gently compressed to insure exit of air bubbles and applied exactly as are plaster bandages. Cement-starch powder and water are thoroughly rubbed into the growing cast. The finished model is smoothed and polished with starch-and-water paste. Casts for the arm or leg should be at least 1 cm. thick after rubbing; and for the body, thigh and hip, they should be proportionately heavier.

For a light-weight cast, subjected to little strain, the mixture may be made of two parts by volume of starch to one part of Portland cement; while for a heavy cast, which may be subjected to considerable tension, the proportion may be reversed.

These casts generally require from twenty-four to thirty-six hours to become thoroughly dry and hard. New types of quick-hardening cement materially reduce the time of setting. During this period, immobility must be assured by cooperation of the patient. Drying may be hastened by the application of hotwater bottles to the cast, by exposure to sunlight, by hair-drying apparatus, or by utilizing one or more 200 cp. electric bulbs.

#### COMPARISON OF CEMENT-STARCH WITH PLASTER OF PARIS

Casts made in the manner suggested compare favorably with those constructed of the ordinary grades of domestic plaster of Paris or dental plaster. They are made of materials which do not deteriorate and which are always available. They are heavier and somewhat softer, and tend to become more moist than plaster casts. They bend readily, but are not so prone to crack. They appear to wear as well as ordinary plaster casts and are easier to remove in either the dry or wet state. Removal is best accomplished after soaking the cast in water to soften and dissolve its starch content. The moistened cement bandage is easily cut with a cast knife or cutter.

Economically, the cement-starch cast is of decided advantage. For example, in Guatemala, the cost of Portland cement is \$0.0132 per pound, and of starch is \$0.119 per pound; while plaster of Paris (French grade) is \$0.30. Furthermore, there is a large percentage of loss from deterioration when ordinary plaster of Paris is used; this must be taken into consideration in making an estimate of the comparative gross cost of the product.

#### CONCLUSIONS

1. Ordinary grades of plaster of Paris are subject to rapid deterioration in tropical climates, which renders them unsuitable for exacting use.

2. High grade French plaster of Paris, packed in small containers, is stable and should be given preference when possible.

3. Mixtures of Portland cement and starch have been used satisfactorily as substitutes for plaster of Paris. The materials are cheap and readily available, and are not subject to deterioration.

4. The cement-starch cast compares quite favorably with casts made of the ordinary grades of plaster of Paris and is superior to those made of deteriorated plaster.

# INTRAVENOUS UROGRAPHY

## BETTER VISUALIZATION WITH COMPRESSION\*

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### HISTORICAL

SINCE 1897 when Tuffier first suggested the use of an opaque internal catheter, the profession has been

raphy, through whose efforts the foundation of this great work was laid.

From 1912 to 1923, the common practice of injecting a 12 per cent sodium iodide

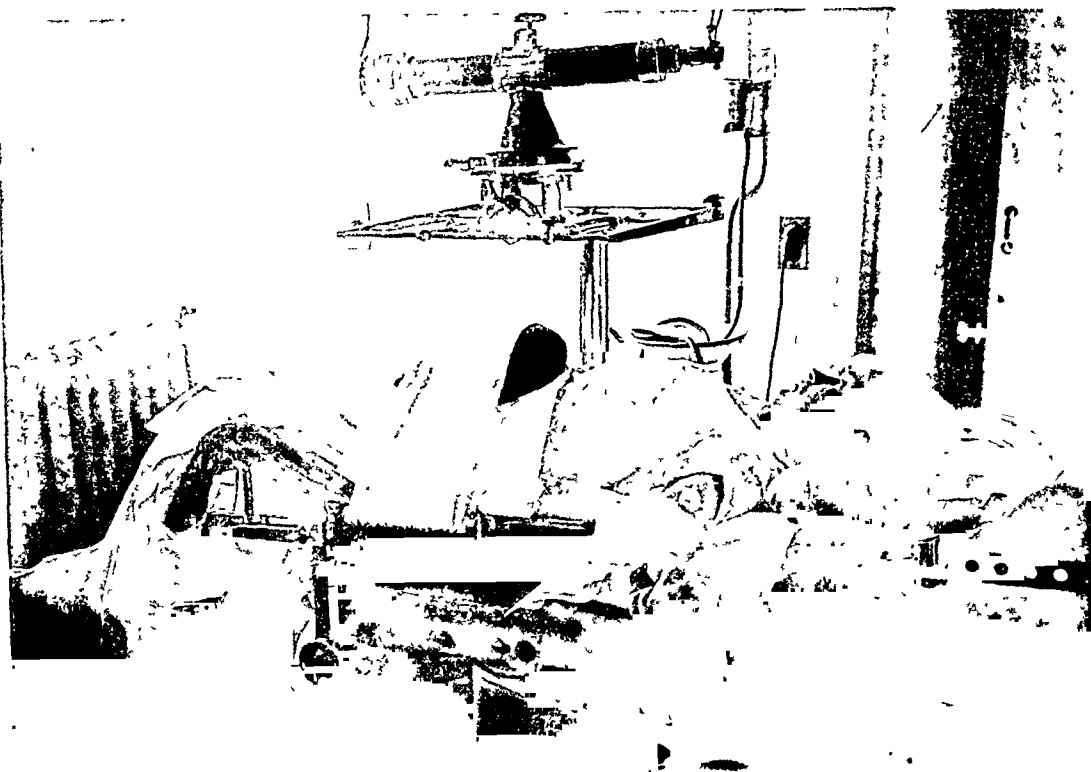


FIG. 1. Hickey bag employed in intravenous urography.

floundering about in an effort to reach the ideal method of clearly demonstrating the outline of the genitourinary tract on the x-ray film. The interim between 1897 and 1912 is now of historical value only. Such men as Klose, Voelcker and von Lichtenberg, Keyes, Uhle and Pfahler, Doderlein and Kronig, Burkhardt and Polano, Dietlen, Kelly and Lewis, Baker, Oehlecker, Stanton and Bruce, Thomas, Braasch, Kidd, Fowler, Schramm, Childs and Spitzer, Alberran and Ertzbischoff, Nogier and Reynard, will always be remembered as the true pioneers of uro-

solution through the catheter seemed the standard method of choice for this work. Urology had now become an independent field of medicine, and urologists seemed satisfied with this method. But in 1923, unrest again prevailed, and now knowing the true limitations of the retrograde method, a new technic of visualization by the intravenous route was sought. The names of Sutherland, Scholl, Osborne, Rowntree, Rosenstein, von Lichtenberg, Volkmann, Lenardouzzi, Pecco and Roseno will always be associated with the newer thought. Although unsuccessful in their

\* Submitted for publication May 21, 1930.





FIG. 2. Female, twenty-eight years old. Tubercular cystitis. Inability to visualize either orifice.



FIG. 3. Male, fifty-five years old. Carcinoma of the bladder associated with a diverticula sac.

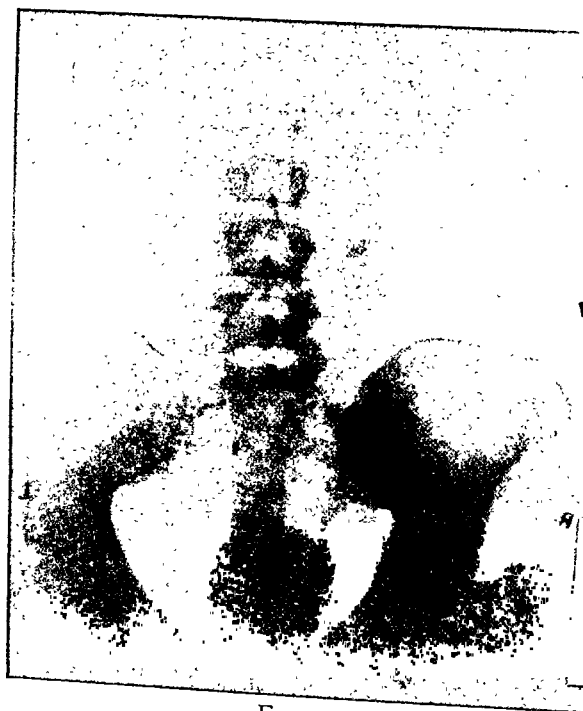


FIG. 4.

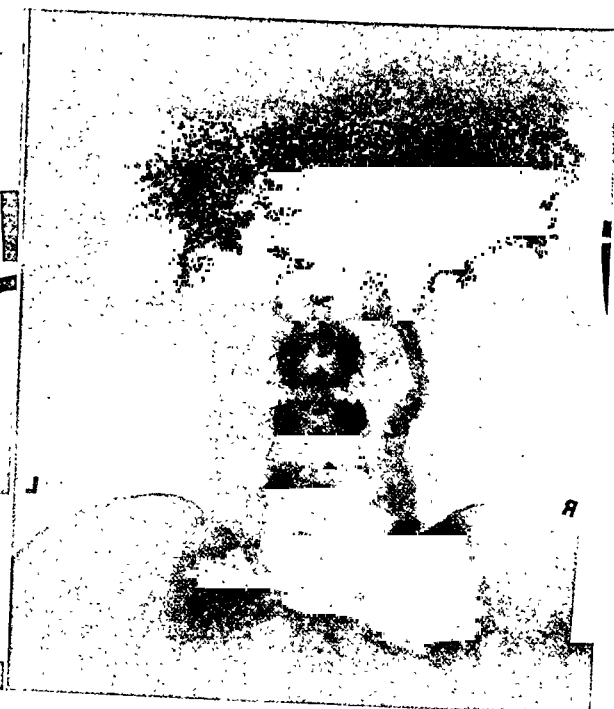


FIG. 5.

FIGS. 4 & 5. Female, thirty-two years old. Carcinoma of bladder. Inability to visualize either ureteral orifice.

attempt, their work will always remain memorable. It remained for Swick in 1929 to give us a non-toxic drug for intravenous

increased density not only of the kidney, but of the entire urinary tract, seems striking in comparison.



FIG. 6. Poor functioning left kidney and kinked right ureter; hydronephrosis and hydroureter on right side.

urography, to which was given the name uroselectan, and with it another rung in the ladder of urology has thus been completed.

#### PRESENT METHOD

The purpose of this paper is to emphasize three important points with reference to the method employed with intravenous urography, viz: (1) compression before and during the x-ray exposures; (2) increase in the dosage of uroselectan; (3) the withholding of urination.

Although mentioned by the originator in his memorable contribution, greater emphasis seems essential at this time. Notwithstanding the fact that visualization without compression may be quite satisfactory in some clinics, with us at least compression has now become an essential part of this new method. This additional effort is more than compensated for by the advantageous results obtained. The



FIG. 7. Normal pyeloureterogram.

**Compression.** The method employed is quite simple. The ordinary Hickey rubber bag is employed as demonstrated in Figure 1, and placed over the bladder region. Enough pressure is used to make the patient just comfortable. This is instituted immediately after the last injection of uroselectan, and allowed to remain until after the first film is taken, then released partly, but retightened within ten minutes before and through the exposure of the second film. The pressure is now entirely released but is reapplied ten minutes before the third, fourth and succeeding exposures, and held compressed during this act. There is no question in our minds that better visualization is obtained by this means, but what the rationale is we are not prepared to say.

**Dosage.** For the adult Swick now suggests a 60 gm. dose of selectan instead of the original 40 gm. dose. The method of dissolving and distilling is carried out as employed by Swick, viz.: dissolving the

drug in warm double-distilled water to a volume of 110 c.c., filtering this twice through ordinary filter paper, and sterilizing the solution in a water bath at 15 lbs. pressure for one-half hour. With the increased dosage we have found no untoward effects, but much better visualization.

*Urination.* Although discomforting to some patients, we try not to allow the passage of urine until after the second exposure. If the desire becomes unbearable, by allowing the passage of a small quantity between the first and second exposures, enough comfort may be obtained to carry on without further interference. Compression, no doubt, adds to this extreme desire, so that with slight releasing of the bag, this discomforting feeling may pass.

#### CONCLUSIONS

1. That all these three points aid

materially in producing a denser roentgenogram is without doubt.

2. What the rationale for this improvement may be we are not prepared to say.

3. Increased dosage to 60 gm. has no untoward effects on the patient.

4. External compression over the bladder as here outlined does improve visualization.

5. The value of intravenous urography, as devised by Swick, is tremendous. Only time will evaluate its true worth.

I wish to thank Dr. A. Wolbarst for having made this work possible by supplying the uroselectan employed and Dr. I. Seth Hirsch for his kind cooperation.

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# ROENTGENOLOGICAL DIFFERENTIAL DIAGNOSIS OF SPINAL PATHOLOGY\*

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THE spine is the most difficult part of the skeletal structure to subject to adequate x-ray study. This is due to its complex structure and its anatomical relationship, causing superimposed shadows which interfere with detail. Clear detail is the prime requisite for satisfactory roentgenography.

Improved appliances and added accessories in recent years have made it possible to obtain splendid x-ray films in both the antero-posterior and lateral views of the spine. The value of the roentgenogram in the diagnosis of spinal pathology is no longer debatable. The intent of this paper is to show its relative value in different pathological conditions; however, these observations will be confined to the bony structure of the adult spine. Pathological conditions in children are worthy of separate study, while diagnostic measures in diseases of the cord or soft tissues require special technic not within the scope of this paper.

For convenience of consideration, the pathological conditions are divided into 3 classes, as follows:

1. Anomalies and curvatures of the spine.
2. Diseased conditions of the spine.
3. Traumatic injuries to the spine.

Anomalies or congenital malformations may occur in any part of the spine, but certain areas predominate, arranged in numerical value in the following order: The fifth lumbar vertebra, the upper segment of the sacrum, the seventh cervical vertebra, the lower segments of the sacrum, and the first lumbar vertebra. The coccyx normally varies considerably and is not included. Variations in the rest of the spine are exceptional.

The first mentioned, the fifth lumbar, is

of unusual interest. Malformations frequently occur and may affect the body, laminae or processes. Occasionally the transverse processes are fused with the sacrum, producing the so-called sacralization of the spine, more often unilateral, rarely bilateral. These processes may also press upon the inner angles of the wing of the ilium; however, an overlapping shadow does not indicate such a condition, as these processes are usually anterior to the ilium with about one-fourth in. clearance. The articular surfaces between the fifth lumbar and the sacrum are often times hazy in the x-ray film, due to deposit in this region, not necessarily pathological, but may be painful if inflamed. The irregularity in the development of the two sides of this vertebra frequently causes a slight tipping of the pelvis. Occasionally the fifth lumbar vertebra slips forward at the lumbosacral articulation, a condition called spondylolisthesis. Usually the angulation is increased so that the upper portion of the sacrum may be almost at a right angle to the lumbar spine, while the normal angulation is about 45 degrees. This can be detected with a good lateral film of this region. Sometimes the fifth lumbar is replaced by an extra, or sixth, lumbar vertebra. This portion of the spine is frequently malformed and quite subject to injury. Perhaps it was originally designed by the all-wise Creator for our horizontally-spined ancestors, slowly evolving toward greater perfection for the comfort of future generations.

The upper segment of the sacrum frequently shows an incomplete fusion of the arch. This in itself is of no pathological significance, but this vertebral segment seems to be more subject to trauma than the normal. The transverse processes of

\* Submitted for publication May 19, 1930.

the seventh cervical vertebra are occasionally elongated or an extra rib formed. This may be unilateral or bilateral and, if of any length, may produce pain from pressure on the nerves or soft tissues. The lower segments of the sacrum are sometimes incomplete, usually unilaterally. The transverse process of the first lumbar are sometimes ununited, usually unilateral but frequently bilateral, or prolonged into an extra rib. The former condition may be mistaken for a fracture of the transverse process, but should be distinguished by the smooth oval appearance of the articular surfaces. True these conditions may cause or contribute to pathological ailments, but they are very often observed roentgenographically in patients free from symptoms. These defects can only be diagnosed during life by means of the x-ray.

The normal contour and degree of motion of the spine can readily be observed by the roentgenologist. The motion between any two vertebrae (except the atlas and axis) is quite limited, although the movement of the spine as a whole is considerable. It can be bent or twisted and if roentgenographed in that position, or if the ray is off center or angulated, the normal spine would appear curved, rotated or deformed. This is worthy of note in medico-legal cases. A fake curvature or rotation can usually be detected by observing the position of certain landmarks. The lower spine should always include the entire pelvis and the symmetry of the spines of the ischae observed. The dorsal spine should include the clavicles and their relative position observed. The structural formation of the bodies of the vertebrae should also be noted.

In a true structural curvature of the spine, there is always rotation of the spine in its vertical axis, with the bodies toward the convexity. Usually this rotation is more pronounced than the curvature. The spinous processes may be in fair alignment; consequently the roentgenogram is the logical way of determining the true degree

of deformity. The normal spine can be flexed equally to either side of the center of the spinal plane, while the structural scoliosis cannot be forced to the opposite side beyond this center plane. This can be demonstrated roentgenographically. A kyphosis always shows compression of some of the vertebral bodies over their anterior portion, conforming to the curve. In a lordosis the reverse is true. This condition is easily checked with the x-ray film.

Forward or backward slipping of the sacroiliac articulation is hard to confirm. A stereoscopic anteroposterior film, using the Potter-Bucky diaphragm, with vertical shift, and guide wire lines transversely across the film at regular intervals, will give the best perspective. Lateral films of the dorsal spine should be slightly oblique, thus partially avoiding overlapping shadows. Lateral views of the cervical region are best obtained by resting the upper arm against the film, tube centered over the shoulder at 50 inches distance.

#### DISEASE CONDITIONS

The spine is subject to practically every disease which may affect any portion of the bony structure. Two diseases, arthritis and tuberculosis, stand out preëminently, and coincidentally their roentgenographic appearances are practically pathognomonic. In adults, the various forms of arthritis predominate, but tuberculosis easily heads the list when diseased conditions in children are included. Clinically, tuberculosis of the spine is probably the easier to diagnose, especially after the disease has reached the destructive or deforming stage. The body of the vertebra is usually subject to attack, first the anterior portion, then the epiphysis under the cartilaginous discs, with early invasion of these discs, producing a collapse of the body into a wedge shape, with sharp angulation of the spine at point of involvement. Tuberculous disease *per se* is purely destructive, but a subsequent or mixed infection will produce an exudate with

thickening or callus deposit. The roentgenographic appearance is characteristic and scarcely can be mistaken. Arthritis is usually classed as atrophic or hypertrophic, with a severe mixed form extensively involving the spine, hips and other joints, called arthritis deformans. This latter is easily diagnosed clinically; the former is difficult to diagnose clinically, but rather easily diagnosed roentgenologically. The atrophic form usually affects the lower spine and sacroiliac regions, producing a diffuse thinning out of the bone, affecting the articular surfaces, cartilage and ligaments, causing severe pain. The hypertrophic form may affect any portion of the spine; the bodies of the vertebrae are usually involved, with exostoses or spurs projecting from their angles; those from the inferior angle project downward, while those from the superior angle project upward, sometimes called "parrot's beak," due to this peculiar formation. At times, this condition is painful, frequently causing little pain relative to the amount of involvement. The roentgenographic appearance is quite characteristic.

Syphilis offers 3 forms for classification: (1) arthralgia, causing pain without destruction of bone and not recognized roentgenographically; (2) necrosis—destructive process of the bodies and intervertebral discs occurring in the lumbar cervical and dorsal regions, in the order named. Kyphosis may result so the diagnosis from tuberculosis may be difficult. The third is Charcot spine, the result of late syphilis with cerebrospinal degeneration. This produces severe deformity with new bone formation, but causes little pain. This has rather a characteristic appearance.

Malignant diseases of the spine are uncommon. Primary sarcoma is occasionally seen, characterized by rapid destruction of the body of the vertebra, with lack of involvement in the discs. Carcinoma is always metastatic, secondary to this disease in some other region. When observed roentgenographically, the aspect

is rather characteristic, showing a diffused, mottled, destructive thinning of the bony structure. This is replaced by tumor mass, so the bodies do not collapse.

Other rare diseases occasionally involving the spine include, osteomyelitis, osteitis deformans (Paget's disease), osteitis fibrosa, hypernephroma, chloroma, progressive myositis ossificans, erosion from an aneurysm, and spondylitis following cerebrospinal meningitis, typhoid, etc., are noted, but they do not offer differential roentgenological signs.

#### INJURIES

Injuries to the spine, include fractures, dislocations and gun-shot wounds.

Statistics show that 60 per cent of spinal injuries are fracture-dislocations, 20 per cent fractures only, and 20 per cent dislocations alone. It is also stated that 50 per cent of spinal fractures are not diagnosed. This is largely due to the fact that the cord is not involved, the case being diagnosed as a sprain. More universal use of the x-ray will undoubtedly lower this large percentage. Fractures of the spine are classified according to the nature of the injury into direct or indirect, those from indirect violence predominating. In these the spine is forceably flexed, causing compression of the bodies, with tearing asunder of the arches and ligaments, while in direct violence the arches are compressed and the bodies separated. In either class the cord is well protected from injury owing to its position near the center of the spine. As stated by Jacobson, "It lies in neutral ground in respect to forces which might cause fracture." It is oftentimes surprising what little damage occurs to the cord in severe injury to the bony framework. In fracture-dislocation injuries from indirect violence the upper segment is usually driven forward on the lower, frequently with partial rotation and some lateral displacement of the body. The first lumbar vertebra suffers more often than any other, due to its location near the center of the spine and at the junction of

the fixed portion of the dorsal spine. Here the leverage would be greatest and this vertebra is slightly smaller than those below. As previously stated, only one-fifth of severe injuries produce dislocation alone. The vertebrae are snugly articulated and securely bound together with ligaments; hence, an injury producing a dislocation would rupture these ligaments and this amount of force usually produces a fracture dislocation. Ordinary strains or sprains do not displace the vertebrae. These bodies are not the nervous, jumpy migratory things some of our modern spineologists would have us believe. In the hundreds of spinal roentgenograms examined I have not seen a displaced vertebra unless caused by severe injury or disease.

Gun-shot wounds differ according to the necessity of removing the foreign

body. The x-ray is then in order. If the foreign body is not producing pressure symptoms or active infection then it is better to leave it alone. This is our conclusion after seeing a large number of these cases in our work with the Veterans' Bureau.

#### CONCLUSIONS

The roentgenogram is the only way of diagnosing anomalies, and the best single method for studying spinal curvatures or deformities. A few diseases show pathognomonic x-ray signs; in others the roentgenogram is a valuable adjunct in diagnosis.

All injuries of the spine, unless trivial, should be roentgenographed in both the anteroposterior and in the lateral projection.



# ROENTGEN LOCALIZATION OF INTRATHORACIC STRUCTURES

WITH REPORT OF FINDINGS IN 19 CASES OF LUNG ABSCESS\*

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**S**TEREOSCOPY and examination of the chest in the lateral position, sometimes combined with lipiodol filling, are roentgen methods commonly used for the intrathoracic localization of normal or abnormal structures. In none of these can any exact information be obtained concerning the location of these structures with relation to anatomical landmarks on the bony thorax.

What I propose here is a simple method whereby the dimensions and location of any structure, whether normal or pathological, may be readily calculated. The method is based on the ordinary stereoscopic roentgenograms made for the diagnosis of suspected intrathoracic pathology.

## TECHNIC FOR ROENTGENOGRAPHY

1. Set up the apparatus for stereoscopic roentgenograms of the chest in the upright position.

2. Center the target of the tube to the center of the plate changer with a target-film distance of 180 cm.

3. Arrange for vertical shift of 7.5 cm. each side of the center or a total shift of 15 cm.

4. Place the identification pad bearing the date in the upper left-hand corner of the plate changer. Place the identification pad bearing the patient's number in the upper right-hand corner of the plate changer.

5. Make stereoroentgenograms with suitable exposure during a single period of inspiration.

This set up is used in all examinations of the chest. The localization of any unusual structure may then be made a part of the first report.

## TECHNIC FOR CALCULATION

1. Place the stereoroentgenograms in the stereoscope, and on one of the films place ink dots on the rib anteriorly and the

TABLE 1

Case	Age	Sex	Dur.	Size	Depth	Loc.	FML	Conf.
I	46	M	3 mo.	3.0 x 1.5	2.0	7LP	8.0	Op.
II	40	M	2 yr.	5.0 x 2.5	2.0	3RA	10.0	Op.
III	29	M	6 wk.	2.5 x 2.5	1.5	2RA	8.0	
IV	16	F	1 yr.	2.5 x 2.5	2.5	8LP	8.0	
V	53	M	6 wk.	2.5 x 2.5	4.0	5RP	8.0	Aut.
VI	31	F	1 yr.	2.0 x 2.5	2.0	8LP	6.0	Op.
VII	70	M	.....	3.5 x 3.0	4.5	4RA	10.0	
VIII	42	M	2 mo.	4.5 x 4.5	2.0	10RP	5.0	Aut.
IX	27	M	3 wk.	4.0 x 2.0	2.0	5RP	8.0	
X	23	M	.....	3.0 x 3.0	3.0	8RP	8.0	
XI	27	F	1 yr.	2.0 x 1.5	3.0	6RP	8.0	
XII	68	M	2 mo.	3.0 x 2.5	2.0	3RA	8.0	Op.
XIII	71	M	2 mo.	2.5 x 5.5	1.0	9RP	8.0	
XIV	37	M	.....	2.0 x 2.0	3.0	7LP	9.0	Op.
XV	40	F	2 mo.	2.0 x 2.5	2.0	2LA	6.0	
XVI	62	M	.....	3.5 x 5.5	4.0	7RP	7.0	Aut.
XVII	31	M	3 wk.	3.0 x 3.0	3.0	6LP	6.0	
XVIII	45	F	3 yr.	3.0 x 3.0	2.0	4RA	8.0	Op.
XIX	30	M	1 yr.	4.0 x 4.0	2.0	2LA	4.0	Op.

Abbreviations: Dur.—duration; Loc.—location; e.g. 7LP—7th rib, left posterior; FML—from midline; Conf.—confirmation.

rib posteriorly at points which lie in a horizontal line with the structure for localization.

2. Superimpose the two films in such a way that the shadows of the markers in the upper corners of the roentgenograms are exactly superimposed and fasten the films together with spring paper clips. Note if the right-hand edges of the films are exactly superimposed and parallel. If they are not, then draw a line marking the edge of the overlapping film. This procedure is to insure a parallel shift in marking the points for calculation.

3. Remove the paper clips and shift the films over one another in a longitudinal direction, keeping the right borders of the films or the border as marked in paragraph 2 parallel and superimposed, until the shadows of the anterior rib marked in paragraph 1 are exactly superimposed. With a needle perforate both films at the point marked in paragraph 1.

\* Read before the regular monthly meeting of the Trudeau Society, Los Angeles, March 25, 1930.



4. In like manner superimpose the shadows of the posterior rib and perforate both films at point marked in paragraph 1.



FIG. 1. Case XVIII. Abscess cavity 3 cm. in diameter. Center 2 cm. posterior to point on upper border of right fourth rib, 8 cm. to right of midsternal line.

5. Superimpose the shadows of the structure for localization, still keeping the right hand borders of the films superimposed and parallel, and clip the films together.

6. Measure the distance in millimeters between the points marked on the anterior rib. This distance times 10 will be the depth of the structure as measured from the point selected on the rib. For example in Case XVIII, Figure 1, when the shadows of the abscess cavity are superimposed the distance between the points marked on the anterior rib is 2 mm. The product of 2 and 10 is 20 mm. Therefore the approximate center of the cavity is 20 mm. or 2 cm. from the point marked on the rib. In like manner the distance may be calculated from the point selected on the posterior rib.

7. Measure the distance in centimeters to the right or left of the midsternal line if the structure is located anteriorly, from

the midvertebral line if located posteriorly. The plane dimensions of the structure may be measured directly from the radiogram.

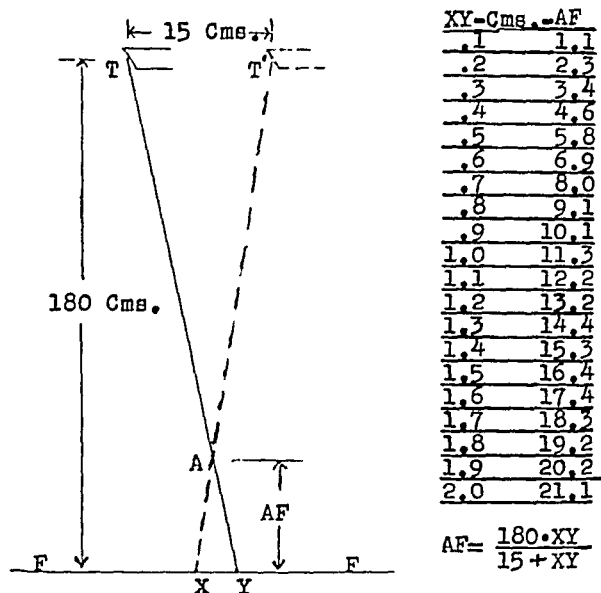


FIG. 2. Relationship of displacement of shadow of point to distance from film, according to formula of Buguet and Gascar. (See text.)

A representative report should then read as follows:

Case XVIII, Figure 1: There is an abscess cavity in the right lung. Its diameter is 3 cm. Its center is 2 cm. posterior to the upper border of the right fourth rib at a point 8 cm. from the midsternal line.

An abscess cavity is roughly spherical or ovoid in shape. Its shadow is cast by those rays tangent to its lateral surfaces. Its approximate center will then lie in the vertical plane of the margins which cast the shadow. The surface of the cavity nearest the chest wall will be closer to the chest wall than the center of the cavity by one-half the shortest diameter of the cavity. In the preceding instance, with a cavity 3 cm. in diameter with its center 2 cm. from the chest wall, the near point of the cavity should be within 0.5 cm. of the chest wall. In practice this has been proved to be approximately correct.

#### DISCUSSION OF THE METHOD

For all practical purposes, a roentgenogram of structures at a maximum distance

of 8 in. from the film taken with a target-film distance of 72 in. (180 cm.) will have a maximum distortion of 10 per cent. The

between their distances from their roentgenogram. For example, in Case XVIII a point on the right fourth rib anteriorly

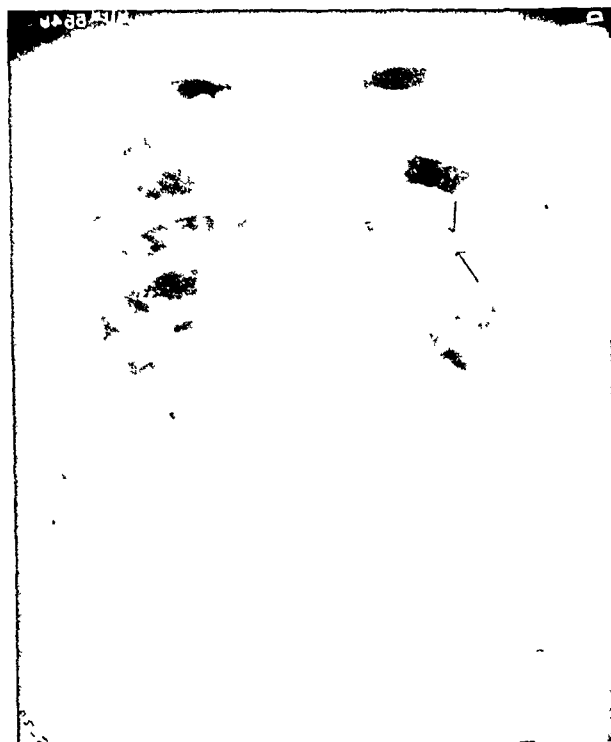


FIG. 3. Case I. Abscess cavity in left lung. Size 3 cm. by 1.5 cm. Its center 2 cm. anterior to a point on the left seventh rib, 8 cm. to the left of the midvertebral line.



FIG. 4. Case II. Abscess cavity in right lung. Size 5 cm. x 2.5 cm. Center 2 cm. posterior to a point on right third rib, 10 cm. to right of midsternal line.

closer the object to the film the less the distortion. Therefore it is possible to measure directly from the film dimensions of length and breadth.

The shift of the shadow of the structure on stereoscopic roentgenograms determines its distance from the film at the time of the exposure according to the diagram, table and formula\* of Figure 2.  $AF$  is the unknown distance of the object from its roentgenogram; 180 cm. is the target-film distance; 15 cm. is the shift of the target;  $xy$  can be measured directly when the stereoscopic roentgenograms are superimposed. By substituting varying values for  $xy$  from 0.1 to 2.0 cm., the values for  $AF$  were calculated as shown in the table.

For all practical purposes an increase in  $xy$  of 0.1 cm. causes an increase of  $AF$  of 1.0 cm. The vertical distance between the depths of any two points is the difference

\* Formula of Buguet and Gascar, 1896.

has a shift in its shadow of 3.0 mm. (0.3 cm.). The margin of the abscess cavity has a shift in its shadow of 5.0 mm. (0.5 cm.). The difference between the shift of the rib and the shift of the cavity is 2 mm. Therefore, the margin of the cavity must be 20 mm. or 2.0 cm. from the rib. If we wish to be more exact, the values of  $AF$  may be found in the table. In this particular instance the depth of the cavity would be the difference between 5.8 cm. and 3.4 cm. or 2.4 cm.

To further simplify the procedure one needs simply to superimpose the shadows of the structure and measure the shift in the shadow of the adjacent rib. This distance in millimeters multiplied by 10 will be the approximate depth of the structure.

#### REPORT OF FINDINGS IN 19 CASES OF SIMPLE LUNG ABSCESS

During the past year this system of

localization has been used in 19 cases of simple lung abscess. Seven of the cases were treated surgically by Dr. H. E. of the lower lobe may lie between the chest wall and the abscess cavity. This occurred in Case xiv.

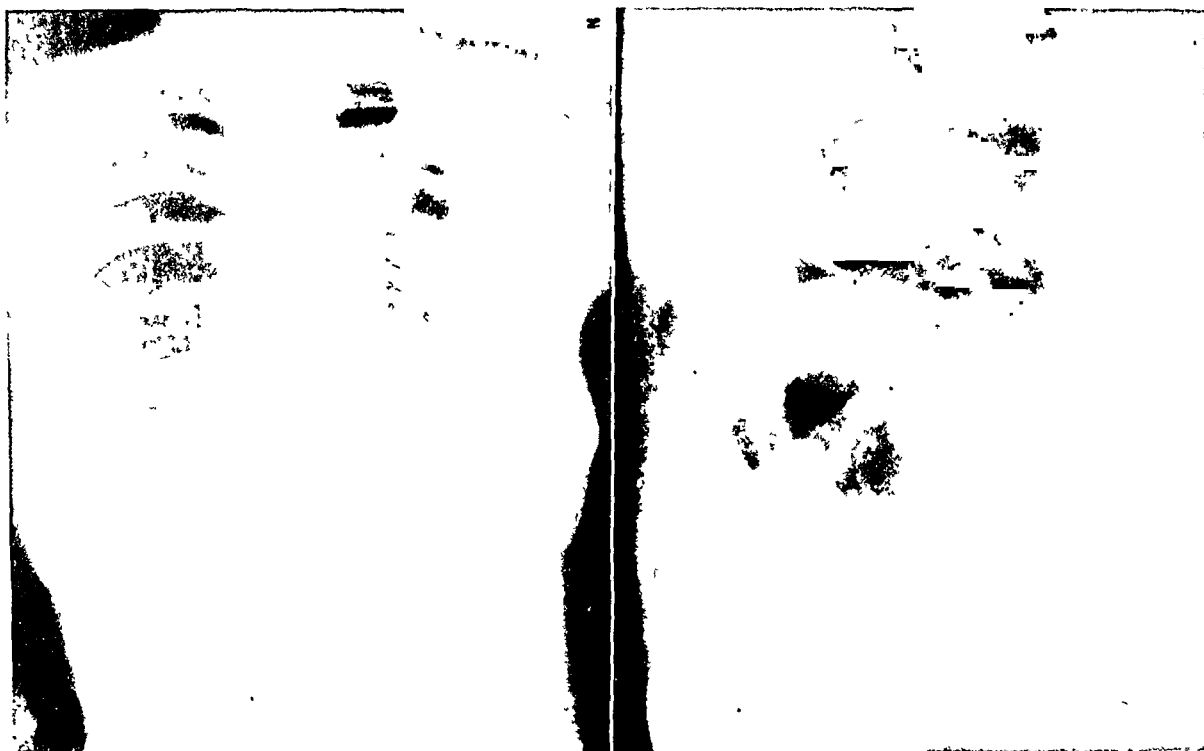


FIG. 5. Case vi. Abscess cavity in left lung. Size 2 cm. x 2.5 cm. Center 2 cm. anterior to point on left eighth rib, 6 cm. to left of midvertebral line.

FIG. 6. Odd-shaped bullet in lower left thorax. Length 3.5 cm. Location 7 cm. posterior to lower border of fourth rib, 10 cm. anterior to lower border of eighth rib, and 3 cm. to midline of sixth rib in midaxillary line.

Schiffbauer, Senior Attending Surgeon on the Chest Surgical Service at the Los Angeles General Hospital. The exact location of the abscess cavity in all of these cases was successfully calculated before operation. The location of four more were confirmed by autopsy. The accompanying table (Fig. 3) gives a summary of the findings in all cases.

On reviewing these findings it should be noted that in the majority of instances the cavity was subpleural. It was located either anteriorly or posteriorly in the thorax. In most cases the cavity was accessible to surgical drainage. We have encountered one type in which surgical approach was somewhat complicated. This type is that in which the cavity occurs along the distribution of the posterior upper lobe bronchus and lies near the interlobar fissure. In this instance the upper portion

#### CONCLUSIONS

Intrathoracic localization may be made a comparatively simple procedure readily applied by the experienced roentgenologist. It is applicable to all those instances where accurate localization of intrathoracic structures may be of value in diagnosis or treatment.

A report of a roentgen examination of the chest is not complete without giving exact information as to size and location of any unusual structure.

This method has been found particularly applicable to the localization of simple non-tuberculous lung abscess cavities, to the localization of foreign bodies within the thorax and to the localization of certain tuberculous lesions.

# RADIATION THERAPY FOR BENIGN UTERINE HEMORRHAGE\*

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THE title of this paper has been chosen significantly, after the elimination of conditions not included in this category.

While the cause of menorrhagia or metrorrhagia was, as a rule, recognized to be a fibromyoma, a number of bleeding patients presented a rather obscure etiology. Six out of the number reviewed were married women between the ages of twenty-five and thirty-six. The diagnosis of fibrosis uteri was suggested tentatively, although the author doubted that this etiology applied to all of this series.

Schmitz<sup>1</sup> presented a logical classification of the types of benign uterine hemorrhages as follows: (a) hyperemia; (b) polymenorrhea; (c) metrorrhagia. The difficulty of differentiating among the three types, however, is evident.

The diagnostic curettage so much heralded by gynecologists, while a necessary prerequisite to radiation therapy, is not always the possible procedure in private practice. Most patients consider this a surgical risk and refuse to submit to it.

Stacy and Mussey<sup>2</sup> limit their curettement to patients more than forty years of age. At any rate, its importance prior to the insertion of radium is obvious.

Thirty-four patients who gave definite physical signs of tumor varied between the ages of thirty and fifty-five. The number of masses felt in the pelvis varied from one small nodule in some, to several large tumors in a few patients. One patient in this series in whom the result was only palliative, had an enormously enlarged uterus, and although the contraindications on account of the doubtful result were explained to the patient, she absolutely refused an operation. She returned recently after a period of six months of freedom from symptoms, with recurrent bleeding.

Another patient in whom the result was poor, proved eventually to have had a benign intraligamentous tumor.

The indications and contraindications were naturally considered. The indications in the majority of patients of this series corresponded with those promulgated by J. C. Mason:<sup>3</sup> (1) past normal age of menopause; (2) history of menorrhagia; (3) tumor less than 15 cm. in diameter; (4) fibrous type uterus; (5) essential uterine hemorrhage; (6) young patients who refuse operation; (7) bad surgical risks.

The chief objective symptom in the author's series was hemorrhage. Subjectively, backache and "bearing-down pain" were the complaints with larger tumors.

The hemoglobin estimation and blood count in a number of patients were always below normal, while in several, the hemoglobin was less than 70 per cent and the erythrocytes fewer than 3,500,000. The hematopoietic regeneration invariably occurred with the cessation of the bleeding.

Since Crile's<sup>4</sup> utterance in 1924 that "in the child-bearing period, radium and x-rays should be used only in the treatment of cancer of the cervix, since surgery relieves practically all cases and preserves the ovarian balance," many investigators, both radiologists and gynecologists, have amply demonstrated the possibility of preserving the conceptive powers of the adnexa exposed to radiation.

While the regional classification was as a rule attempted, the uncertainty of accuracy readily suggests itself, in view of the fact that a mass felt subserously may be wholly intramural where most of the fibromyomata originate. Furthermore, the presence of a subserous mass does not eliminate the possibility of a submucous nodule. Although the clinical results are

\* Submitted for publication April 2, 1930.]

uniformly good, the regional classification is also important in indicating the proper type of emanator of radiant energy. The *submucous* fibromyomata or *pedunculated* tumors are likely to ulcerate on account of the too intense *radium* bombardment. Better results may be expected with x-rays, although pedunculated tumors should be removed *surgically*. The large *subserous* fibromyoma does not react so well with *radium*. The reason for this may be explained as follows: the radium applicator being inserted in the uterus is a goodly distance from the mass, especially if the latter is centripetally situated. Furthermore, the intensity of radiation varies as the square of the distance, hence an insufficient amount of rays reaches the subserous neoplasm. However, radium is the applicator of choice in young women suffering from idiopathic uterine hemorrhage because the dose to be applied can be controlled more accurately. Clinical experience has taught us that 250 to 800 milligram or millicurie hours will produce a temporary amenorrhea which may last two to six months. The castration dose is two to three times greater.

In the author's series radium was applied eight times with invariably good results. In only 1 of the 6 (aged thirty-five) hemorrhage cases a permanent amenorrhea was produced with the x-rays. In another of this series, the patient became pregnant some months later. Phahler<sup>5</sup> cited his unusual experience with a patient in whom a uterine fibroid disappeared with irradiation without a temporary amenorrhea. Subsequently she gave birth to two healthy children.

Although the author has by choice employed the x-rays, he did not hesitate to use radium where indicated and the patient's financial status permitted it. The cost of radium and the necessary hospitalization are an item which is a serious consideration to the patient of moderate means.

At present the author employs deep penetrating x-rays of 180 kv. peak and filtered by 0.5 mm. of copper and 1.0 mm.

of aluminum. The target to skin distance is 50 cm. Fractional exposures twice weekly are given until a full erythema dose is administered. This is usually completed within three weeks, depending upon the urgency. Other series are repeated within six weeks as indicated. Some tanning and an occasional bronzing of the skin occur.

In most patients radiation is given through one portal, 15 cm. in diameter in the suprapubic region, and another through the sacral region. In some patients with multiple tumors, irradiation is done through a portal on either side of the median abdominal raphe.

The irradiation with radium involves hospitalization of the patient, meticulous preparation of the genitalia and the patient as for major surgery; the properly prepared radium salt or emanation is then inserted into the uterine cavity. The dose given varies from 250 to 2000 mg. hours or its equivalent in millicuries.

#### RÉSUMÉ

1. Radiation therapy is an excellent remedy for benign uterine hemorrhage due to fibromyomata or the type classed as idiopathic, with few exceptions.
2. X-ray therapy is superior for all types of fibromyomata and it is also less expensive for the patient of moderate means.
3. Radium is an excellent remedy in selected cases, especially in young women, but more expensive.
4. Finally, radiation therapy is a potent but a dangerous remedy in the hands of the tyro. Improper irradiation unwarrantably discredits a fine therapeutic agent.

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# A PRACTICAL X-RAY SERIALOGRAPH\*

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THE writer wishes to present herewith an x-ray accessory for making serial roentgenograms, and a method of

lastly the backing of wood and bakelite to give it strength and rigidity. Through an opening near the bottom of one side

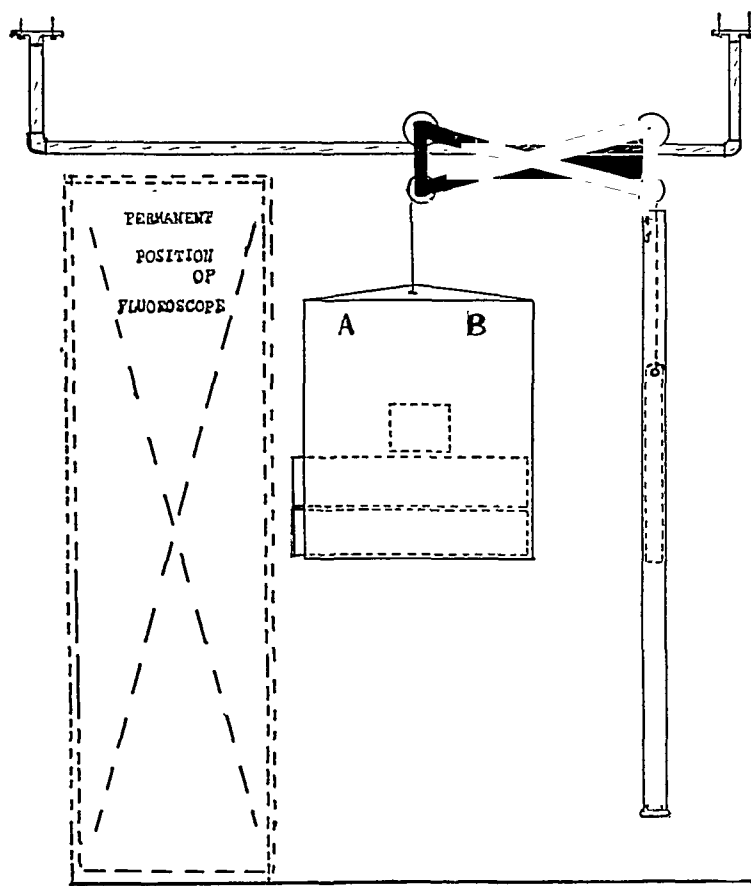


FIG. 1.

suspending it in a convenient manner in a permanent installation alongside the fluoroscope.

The tunnel is made to accommodate one regular 10 x 12 in. cassette, and produces on this film six separate roentgenograms, each taken a short interval after the preceding one. This tunnel is 20 x 24 in. outside measurement and weighs about 32 lb. It is made up in the regular manner with a sheet of 1 mm. of aluminum next to the patient, then a sheet of lead 2 mm. thick with the 4 x 5 in. aperture in its center; then the proper space for the cassette, and

are inserted two strips of wood 4 in. wide and 22 in. long.

In operation, the tunnel is pulled along on its trolley and then lowered between the patient and the fluoroscopic screen; the portion desired is then centered in the 4 x 5 in. opening, and the patient by grasping the edges of tunnel and fluoroscopic screen holds all tightly against his abdomen. The 10 x 12 in. cassette is then inserted in the space at top and brought over to position "A" and an exposure made, then the cassette is moved over to position "B" and the second exposure

\* Submitted for publication May 23, 1930.

made. The upper of the two wood strips is then pulled out, allowing the cassette to drop down 4 in., and two more exposures are made in a similar manner, and then the bottom board is pulled out and the last two exposures made. In this way six exposures are quickly made, each 4 x 5 in., on one 10 x 12 in. film, and all six are right side up instead of two right and two upside down as with the original model on which this idea is an improvement.

The trolley system consists of 1 in. gas pipe fastened by floor plates to joists in the ceiling by lag bolts. This is constructed and placed in such a manner that no portion comes nearer to the overhead high tension wires than the original construction of the fluoroscope involves, passing entirely under and around the wires in cases where they approach the fluoroscope from the front. The trolley wheels are

turned to fit the pipe and by bracing as shown a very light yet rigid construction is achieved. The counterbalancing system consists of the nickel-plated tubular standard of an old x-ray tube stand and its original weight sliding within it. The tunnel and weight are easily equalized by melting out or adding to the required amount of lead.

When not in use, the entire apparatus is easily shoved over to one side on the trolley where it remains always ready for instantaneous use.

For handling the cassettes when within the tunnel, one may bore a hole near the corners at one end into which are fitted the hooked ends of a wire bail. This does not injure the cassette, is more convenient than a pan, and does not alter the cassette so as to prevent its use in the ordinary manner.



## THE ACHIEVEMENTS OF UTEROSALPINGOGRAPHY\*

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**I**N THE year 1914 Dartiques and Dimier by their "Radiographie Periuterine et Endouterine" introduced for the first time the new method of uterosalpingography. Independently, Cary of Brooklyn and Rubin of New York advanced the identical method in 1914. Regarding priority, the credit can be given to Cary and Rubin as Dartiques and Dimier did not give their results publicity until 1916.

Since then uterosalpingography, or as some prefer to call it hysterosalpingography, has proved almost indispensable in certain phases of diagnostic gynecology and obstetrics, and has revealed new facts in the anatomy and physiology of the female genital organs.

The success of uterosalpingography depended entirely upon the use of a proper medium which had not only to give a strong x-ray shadow, but at the same time avoid any harmful action on the tissues. Dartiques and Dimier used 7 to 8 c.c. of a 10 per cent collargol solution for the visualization of the uterus and adnexa. Later on argyrol and bismuth paste were used by others. But these solutions did not give satisfactory x-ray shadows and furthermore caused untoward effects, such as peritonitis, abscess formation and adhesions. It was due to the failure to find a proper agent that uterosalpingography was not generally applied as a diagnostic method until about 1923.

In the interim Zimmerman used umbrenal; but this had a very bad effect on the mucous membrane of the tube and on the peritoneum of the Douglas pouch and therefore failed to gain general acceptance.

In the search for satisfactory contrast material many men deserve credit. For the sake of brevity we shall only mention

the following few: Mocquot, Tussau, Schneider, Jarochka, Arnstam, Serdukoff, Carelli, Randall, Kennedy, rather an international galaxy and showing the study to be of widespread interest.

Among the agents most widely used were bromnatrium, collargol, argyrol, sodium iodide, iodakol, iodipin and lipiodol. At first the solutions containing iodine were used with care and trepidation because of the fear that they might have a destructive action on the tubal epithelium or show toxic effects. But experience showed that these considerations were not warranted.

Among the iodized oils, iodipin and lipiodol gained foremost reputation due to their merits and recently the latter has almost unanimously been given first choice. Iodipin was first used by Winternitz. One cubic centimeter of iodipin contains 0.51 gm. iodine in an organic combination. In the opinion of Zimmerman and Nahm-macher it is harmless to the ciliated epithelium of tubal mucosa and its only drawback is its heavy viscosity. But Dyroff claims it to be decidedly harmful because it causes oily deposits of long duration, fibrinous exudates and adhesions.

Lipiodol was used by Lafay in 1901 for therapeutic purposes only and as contrast material in 1925 by Sicard and Forestier. One cubic centimeter of lipiodol contains 0.54 grams of iodine in a vegetable oil combination and is tolerated by the organs with which it comes in contact as the least irritant of all known solutions and gives the sharpest x-ray shadow.

Preliminary to uterosalpingography the patient should receive a bowel evacuant the night before, and be put on the x-ray table with an empty bladder. In order to gain better visualization, Saint Portret

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and Dimier recommend rectal and vesical insufflation; Heuser, Carelli, O'Campo and Arens favor a pneumoperitoneum in conjunction with the uterosalingography, but it may be safely said that no special advantages can be gained by the use of this combined procedure.

The instrumentarium is simple and easy to handle. It consists of a vaginal speculum, a tenaculum, a syringe with long nozzle and the contrast material. Some prefer to introduce the contrast material by means of a catheter, others use the rigid nozzle. Some have a special pressure-reading attachment on their syringe in order to control the applied pressure, as in the "Schneider-Beclere Hysteromanometre." Others use a different sized nozzle, still others apply a rubber stopper on the nozzle to prevent the backflow of the injected solution, and some use both. Temesvary attaches his syringe to the tenaculum in such manner that the nozzle is held firmly in the cervix and at the same time the cervix is pulled down. In this way the injection can be managed with one hand. An inexpensive and yet very efficient one is a modified Ultzman-Record syringe.

The appropriate time to do uterosalingography is midtime between menses. Shortly before or after menstruation the swelling of the endometrium may occlude the uterine ostia of the tubes and prevent the contrast material from entering into them.

The instruments used must be sterile and the procedure executed under strict precautions of asepsis. The technic is as follows:

The patient is put on the x-ray table, recumbent, or as some prefer, in the stone-cutting or Trendelenburg position. The vaginal speculum is inserted, the vagina and cervix thoroughly disinfected and after the cervix is grasped, the nozzle of the syringe is inserted into the canal and the lipiodol injected slowly, about 1 c.c. per minute. Those who use the manometer, control the applied pressure by the reading; but their recommendations vary from 60 to

200 mm. Hg pressure, sufficient proof that this precaution is unnecessary. The best manometer after all is the hand, which will recognize readily any undue resistance and will not assert itself against it. As to the quantity of the injected fluid, no definite ruling can be set: it varies with the individual case.

Some precede the radiography by fluoroscopy. Fluoroscopy will give information about the degree of filling and the contractions of the uterus; but as to finer details, only the radiography is satisfactory.

If only information about the uterus is sought for, the radiography may follow immediately upon the injection; but if the tubes have to show up on the plate, it is safer to wait from eight to ten minutes. A second and third film should be exposed one hour and three hours after the first picture, but without repeated injections. These radiographs are made for the sake of control and for further information about the localization of the contrast matter.

In case the tubes are patent and the lipiodol reaches the abdominal cavity, it will undergo absorption there. As to the length of time that this will require, the opinions vary: some believe a few days, others claim that it takes weeks or months. When found at any later date in the abdomen it never seems to have caused any irritation of the peritoneum and in Schober's examinations these lipiodol rests were always sterile.

Gregoire and Darbois employ lumbar anesthesia but this is not necessary because uterosalingography hardly ever causes any pain beyond discomfort of short duration. In fact it is tolerated much better than gas insufflation.

In regard to the anatomy and physiology of the female genital organs, uterosalingography has revealed the following facts:

The position of the uterus is rarely in the midline of the pelvis; but I myself am inclined to believe that this deviation from the pelvic axis is due to the traction exerted upon the cervix during manipulation. The cavity of the normal uterus is always

triangular. This triangular shadow varies in size on the x-ray film and is dependent on the position and version of the uterus. The more stretched the uterus is, the higher will we find this triangle to be: retroversion without retroflexion enlarges the shadow cast upon the film, and the more pronounced the retroflexion, the shorter it will measure.

At the fundus from cornu to cornu, this shadow measures from 3.6 to 4.3 cm. in normal uteri. From fundus to cervix, the measurement varies; but if it is over 4 to 4.5 cm., it is in direct ratio to the retroversion.

The uterine cavity fills up with 3 to 10 c.c. of lipiodol in normal conditions, dependent on the tonicity of the musculature and the applied pressure.

Reinberg and Arnstam observed under the fluoroscope that after filling the uterus by way of a catheter, in some cases part of the contrast material was at once expelled back into the vagina, and part of it was forced through the tubes into the abdomen. From this they concluded that there is not only an expelling muscular action of the uterus, but also a peristalsis on the tubes from cornua to fimbriated end. It is known that the normal peristalsis is from fimbriated end to cornua; but that there is also an antiperistalsis is proved by Henkel, who injected only 0.5 c.c. of iodipin into the uterus, placed the patient in Trendelenburg position, and on radiography half an hour later, found the iodipin in the tubes. Temesvary and Mikulicz believe that antiperistalsis takes place only if the backflow of the contrast material meets obstruction in the cervix. They introduced into the uterine cavity a lipiodol saturated applicator and upon withdrawing this quickly found that the expulsion of the lipiodol took place towards the vagina. However, if they left it in place so as to occlude the internal os, the lipiodol was observed to ascend into the tubes. On the x-ray film the peristalsis of the tubes can be recognized by the fact that the contrast material does not give a continuous

shadow, but that it is broken up into fractions.

In 1926 Heuser from his observations concluded that there is a salpingouterine sphincter action and later Romcke proved this physiological supposition by his anatomical findings. This sphincter is situated about the middle of the intramural section of the tube. Its presence was proved by Schneider and Eisler on the basis of manometer readings. On the removed organ this sphincter is tetanic enough so as not to allow the filling of the tubes from the cervix, whereas in the living organ, the same specimen showed easy permeability. In the living, due to some unknown reason, the sphincter may be in a spastic stage and, in order to differentiate between such state and an organic, permanent obstruction at the sphincter's site, atropine should be given to the patient ten minutes prior to the injection of the lipiodol which will bring about a relaxation if the closure is only functional.

The tube is capable of elongating to an unbelievable length, as is seen in cases of prolapsed uteri where the cervix protrudes beyond the labia and the tubes remain in the pelvis and reach far up.

Further facts revealed by uterosalpingography and reported by Susaki are:

Thirty days after birth the uterus is still not normal in size. The cervix assumes its prenatal form in multiparas much sooner than in primiparas and in the early puerperium we find the uterus mostly in an anteversion and anteversion. In the late puerperium it is mostly in retroversion.

Besides these ascertained anatomical and physiological factors, uterosalpingography offers more valuable service in diagnosis. Its foremost application is in cases of sterility. According to Jarcho, "it not only supplements but frequently supplants insufflation of gas." If the Rubin test shows the tubes to be patent, reasonable doubt can be maintained whether one or both tubes are permeable, and if the manometer reading indicates obstruction, information as to the site of the trouble is

still missing. These drawbacks are eliminated by the properly executed uterosalingography. It gives us information about both tubes and by localizing the site of lesion will indicate operative possibilities for the cure of sterility. Furthermore the iodized oil may have definite therapeutic advantages in subacute and chronic conditions of the Fallopian tubes.

If the tubes are patent we will find on the x-ray film shadows of droplets and clots of lipiodol in the free abdominal or pelvic cavity. If the tube shows up as possessing a blunt end, like a club, one must not conclude from this appearance that the fimbriated end is closed; there is a possibility that the lipiodol is filming it and gives the impression of obstruction. In such doubtful condition it is advisable to follow up with another radiograph an hour or two later, to search for the only conclusive signs of tubal patency, i.e. droplets and clots of lipiodol or to repeat the whole procedure by applying more pressure during the injection.

Henkels and Rouves base their diagnosis of ovarian tumor on the fact that the tubes appear extraordinarily elongated. The diagnostic point of Rosenblatt and Kesz is, that the surfaces of these growths become covered with lipiodol and show up as some part of a spherical body. According to others the diagnosis is made on the basis of negative x-ray findings, i.e., the tubes and uterus are normal but the clinical findings point to some growth.

In differentiation of myomas it is fairly satisfactorily established that in submucous myomas we will find a filling defect in a deformed uterus. In intramural myomas, instead of the triangular uterine shadow, we will find an asymmetrical and deformed one. We are to note that a submucous myoma of the posterior wall will show up only if the film is exposed in a lateral position. Incidentally I wish to mention that Samuel noticed, upon using a 25-30 per cent sodium bromide solution as contrast material in the visualization of myomatous uteri, that as a sequel these

myomas decreased essentially in size and that the menorrhagia diminished. It is explained by the dehydrating action of this highly concentrated and hygroscopic salt solution.

The diagnostic signs of a four to six weeks' pregnancy are according to Popovitch the following:

1. Form changes, i.e. the uterus is larger, symmetrical and atonic.

2. Under the fluoroscope irregular contractions are observed.

3. These contractions become regular, almost rhythmical, under the influence of pituitrin.

4. A filling defect is seen in some part of the uterus corresponding to the location of the ovum. This defect is always convex, broader than long, and the edges are never clean-cut, in differentiation from a submucous myoma.

In missed or incomplete abortion all these signs may be detected except the last mentioned one. The filling defect is not present and instead, according to the fact that the contrast material has mixed rather unevenly between the different and loose parts of the products of conception, the picture is that of a spherical bag filled with different sized and shaped fragments of lipiodol shadows.

In spite of the fact that many men, as Carlos Heuser, Dyroff and Arnstam have applied uterosalingography to determine a question of pregnancy and have claimed that it is harmless to the mother and that it does not bring about an abortion, Joachimovitz found that iodine absorption takes place readily in pregnant women, causing severe acne eruption. Many others would not apply this diagnostic method for fear of harming the fetus. We are inclined to take sides with the latter and esteem pregnancy as one of the contraindications to uterosalingography.

In the diagnosis of tubal pregnancy the following points may be utilized:

1. The gravid tube either does not fill with contrast material at all or fills up only very slowly and to an insufficient degree.

2. The isthmic portion of the tube is larger than usual.

3. In the pregnant tube the distal end of the contrast material shadow stops suddenly and is concave towards the fimbriated end. This phenomenon is explained by the fact that both the lipiodol and the tubal contents as a whole are elastic bodies and on the surface of their contact the tubal contents will resist the pressure of the lipiodol, causing it to stop in a concave line.

4. Sometimes the gravidity filling defect can be seen in the tube.

5. The previously mentioned signs of pregnancy are present on the uterus itself.

It must be remembered that in tubal pregnancy uterosalphingography involves some danger through the possibility of causing a rupture.

Other uses of this method are in the diagnoses of malformations, in the differential diagnosis between uterine and adnexal tumors and in certain postoperative follow-up cases.

As contraindications, the following are generally accepted: fever, gonorrhea, preg-

nancy, malignancy and inflammations, although Cotte and Bertrand apply it even in such cases for therapeutic purposes.

Before closing this review I want to call attention to a perversion to which uterosalphingography has led some men. They have injected 15 to 20 c.c. of lipiodol by way of a Douglas puncture in order to reveal diagnostic facts in cases of tumors and adhesions. It is needless to say how hazardous and unnecessary is such an undertaking.

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# DISPLACEMENTS OF THE UTERUS\*

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ONE must at least briefly review the normal supports of the uterus before entering upon the discussion of the subject of uterine displacements. Usually we find that the displacements follow upon damaged or diseased supports. Under normal conditions the tone of the supportive structures is sufficient to maintain the uterus in good position.

The uterine supports are loosely arranged in order that the uterus may undergo considerable mobility. The pregnant uterus gradually changes its position from the beginning to the end of pregnancy. This marked alteration in position and size of the uterus could only occur with loosely arranged attachments. The degree of fullness of the bladder alters the position of the uterus. The normal degree of uterine antifixion can only occur when the bladder is empty. A distended lower bowel tends to push the cervix forwards and this will carry the uterus backwards. Physiologically the uterus will be in its most normal position when the bladder and rectum are empty or nearly so.

The peritoneal ligaments are morphologically of the nature of a mesentery. They carry the nerves and blood vessels to the organ and offer resistance only to gross displacements, leaving the uterus a wide range of mobility. The mobility of these attachments allows of the uterus being drawn forwards and upwards to or through the abdominal wound during operation. These ligaments therefore are not normally true supports of the uterus. The round ligaments compare morphologically to the gubernaculum testis of the male. The function of this structure is developmental only and the portion which becomes the round ligament may be regarded as a vestigial structure which serves no definite purpose in the adult.

Its normal laxity and its marked variation in size seem to obviously mean that it has but little to do with holding the uterus in its normal position. These ligaments are serviceable however to the surgeon when he wishes to use them as supportive structures.

The uterus is held in position mainly by the fascial and muscular structures which also serve to close over the lower part of the pelvis. These structures may be conveniently arranged into two groups, (a) the superficial and (b) the deep. The superficial or sphincter group is made up of: the superficial sphincter ani; the transverse perinei; and the sphincter vaginae muscles; along with the superficial and deep layers of perineal fascia. The deep group constitutes the pelvic diaphragm. It is made up of the levator ani and the coccygei muscles, along with the visceral layer of pelvic fascia. This pelvic floor is weakened by the passage through it of the vagina and the urethra. This element is however partly counter-balanced by the fact that the vagina and urethra are attached to the sloping sides of the pelvic floor by a layer of pelvic fascia which is continuous with the general pelvic fascia and attached to the pelvic wall at the "white line." Another assisting factor is that the uterine vessels bring with them an investment of fibrous tissue. The so-called transverse cervical ligament adds further support. The definite support offered by this fibrous tissue around the lower uterine segment and upper part of cervix is appreciated in doing a vaginal hysterectomy. It is difficult to pull the cervix down to a lower level until these lateral attachments have been severed. When the uterine vessels and transverse cervical attachments have been severed the cervix can be readily pulled downwards,

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as the upper peritoneal attachments allow so much mobility that the uterus may be readily delivered and freed from those attachments. The uterus is therefore maintained at its normal level chiefly by the following supports: (1) pelvic diaphragm, (2) transverse fascial and fibrous bands, (3) fibrous sheaths of blood vessels.

The displacements of the uterus may be considered as follows:

(a) Forward displacement: anteversion, antelexion.

(b) Backward displacement: retroversion, retroflexion.

(c) Downward displacement: prolapse.

(d) Inversion: turning inside out.

*Forward Displacement:* Anteversion is the normal position of the uterus. The degree of anteversion will vary with the filling and emptying of the bladder.

Antelexion may be congenital or acquired. The congenital variety is rare. It is often associated with some degree of under development of the uterus. The functioning of the ovary in these cases may not be normal. The acquired type may result from a uretosacral cellulitis, or from certain pelvic adhesions. The uterine angle is reduced below a right angle and a consequent abrupt bend in the curve of the uterocervical canal. The diagnosis is made by the finger on bimanual examination or by use of the uterine sound. All such cases are not necessarily pathological. The two main symptoms of pathological antelexion are spasmodic dysmenorrhea and sterility. In the congenital variety the deficient development of the organ may account for the symptoms and not the acuteness of the angle. The treatment of the congenital type is at times discouraging. In a few cases pregnancy ensues and the condition is cured. Dilatation of the cervix usually gives but temporary relief. Electrical stimulation has proved discouraging. Stem pessaries help temporarily. In the chronic type of forward displacement the treatment is that adopted for pelvic inflammation.

*Backward Displacement:* The uterus may

be displaced considerably backwards without in anyway interfering with its normal function. Every case of backward displacement is not pathological and does not require treatment. The condition is often incidentally discovered. The backward displaced uterus may or may not interfere with insemination. Many women with backward displaced uteri conceive and go through a normal pregnancy. The backward displaced uterus may encounter some difficulty in properly emptying itself during a menstrual period. A uterus with good muscular tone may empty itself without difficulties against gravity. In certain cases muscular spasms result with pain or dysmenorrhea. The retroverted uterus may cause varicose veins in the pampiniform plexus of the broad ligament. This is due to the broad ligament being folded backwards over the edges of the uterosacral ligaments. This causes stasis and engorgement of those veins. Varicose veins of the broad ligament can cause a dragging pain in the lower lumbar region. This becomes more marked premenstrually and menstrually due to the increase in the pelvic blood supply at that time.

Retroversion has often been found in the newborn baby. This congenital type may remain retroverted or may later in life be found corrected. At times one finds a patient with a retroversion today and in a few days' time the uterus is found in quite good position. Such uteri as these seem to have a marked degree of mobility and they doubtless change their positions many times during the patient's life, without causing symptoms.

The first degree of backward displacement is that in which the uterus is lying much in the same position as it is when being pushed backwards by a full bladder. This is spoken of as a retroposed uterus. The further degrees of retroversion will vary from that of a retroposed uterus to the uterus which is forward lying on the floor of the pouch of Douglas. We may therefore for clinical purposes consider

retroversion in three stages or degrees. The first stage being the retroposed uterus, the third stage being the extreme degree when the uterus is lying on the floor of the pouch of Douglas. The second stage refers to the position of the uterus when it is lying midway between these two positions.

The causes of acquired backward displacement may be grouped as follows: (a) relaxation of the uterine supports, (b) abnormal size and weight of uterus, (c) abnormal intra-abdominal pressure, (d) pelvic adhesions. The relaxation of the uterine supports along with an increase in size and weight of the uterus are the two factors which occur together post partum. It is therefore obvious why backward displacement is rather frequently found during this period of the maternity patient's convalescence. Backward displacements occurring at that time are usually amenable to simple treatment if such is instituted at the proper time. Doubtless many of these acute puerperal displacements do return to normal, yet many of them become chronic backward displacements and later give rise to symptoms.

Many backward displacements remain as simple backward displacements and symptomless. Others are complicated and are accompanied with symptoms. The most common complication is descent. This means that the displacement is accompanied with a certain degree of descent of the whole organ. Another complication is prolapse of the ovaries. Often one or both ovaries will be found lying on the floor of the pouch of Douglas. Pelvic inflammation is usually an associated condition and not a complication. This condition requires operative treatment for correction of the retroversion. A uterine fibroid is also an associated condition rather than a definite complication of the displacement.

The symptoms of backward displacement vary considerably. As stated above, many backward displacements do not cause symptoms. The usual symptoms are

(a) pain in the sacral region and the lower abdomen, (b) menorrhagia, (c) dysmenorrhea, (d) leucorrhea, (e) sterility, (f) dyspareunia. These same symptoms are often found from other causes than backward displacements. The pain with backward displacement is not acute. It is usually in the form of a backache or a dragging sensation in the sacral region and in the lower abdomen. The pain is more marked when the ovaries are prolapsed. The menorrhagia may be the result of the accompanying endometritis. Dysmenorrhea is the result of the congestion along with the abnormal direction of the uterine canal. Sterility may only occur in a few cases of backward displacement. Urinary incontinence and bladder irritability if present are *not* due to the backward displacement.

The treatment of backward displacement of the uterus will vary somewhat according to the individual case. The treatment may however be conducted somewhat as follows: (1) In young unmarried women and in women who are long past the climacteric, if the case is uncomplicated, treatment is not required. (2) In sterile married women the displacement may be corrected even if no pelvic symptoms are present. (3) Cases occurring in married women in whom the ovaries are prolapsed usually require treatment. (4) Puerperal retroversions should always be corrected.

The actual treatment is essentially one of two forms: (a) pessary treatment, (b) operative treatment. Pessary treatment gives the best results in puerperal retroversions. In practically all other cases the pessary gives only temporary relief. The prolonged use of a pessary is objectionable, since it is difficult to keep clean and it may also cause ulceration. The pessary seldom ever cures a retrodisplacement except the puerperal cases. An operation suitably planned involves but little surgical risk and almost invariably presents a recurrence. A pessary used for puerperal retroversion should be inserted

reasonably early. It gives best results if used not later than the sixth or eighth week. A Smith or Hodge pessary is the one usually used. The patient takes a daily douche of a quart of warm water containing a teaspoonful of sodium bicarbonate. The pessary should be removed, cleaned and reinserted. At the end of about three or four months the pessary is removed and the patient goes one month without it. She then reports again for an examination. If the uterus is again out of position, the pessary may be tried for another month. At the end of this time it should remain in proper position without the pessary; if not, an operation is advised. Before attempting to replace a retrodisplaced uterus one should make sure that the lower bowel has been thoroughly emptied; also the bladder. In certain cases one may find it necessary to anesthetize the patient. Generally speaking this is not at all necessary.

The operation of choice for backward displacement is intraperitoneal shortening of the round ligaments, known as Gilliam's operation. This operation leaves the most normal uterovesical pouch. It also has the distinct advantage of not leaving any intra-abdominal structure around which the bowel may become entangled. One other distinct advantage is that if a pregnancy should follow it allows of practically normal and free mobility of the uterus upwards during its development. The uterus should *never* be fastened to the abdominal wall during the child-bearing period.

Prolapse is a complex condition which may involve several pelvic structures. There are five clinical varieties of prolapse: (a) Prolapse of the anterior vaginal wall (cystocele); (b) prolapse posterior vaginal wall; (c) prolapse of the anterior and posterior vaginal wall (cystocele and rectocele); (d) prolapse of the anterior vaginal wall and uterus; (e) complete prolapse of the uterus with inversion of the vagina (procidentia). Hypertrophic elongation of the cervix is a different condition and will not be considered here.

It is therefore clear that prolapse is not a displacement of the uterus alone, but usually the vaginal walls are involved in the descent as well as the uterus. In advanced cases we find that the bladder, rectum, fallopian tubes and ovaries, the broad ligaments, and even coils of intestine and omentum may form part of the prolapse.

Prolapse is really a hernia. It consists of a protrusion of the pelvic and abdominal contents through an aperture in the supporting structures. The coverings of the hernial sac are the vaginal walls and peritoneum. The hernial aperture is formed internally by the interval between the levator ani muscles and externally by the ostium vaginae.

Prolapse is much more common in multiparous patients than in nulliparous patients. Mechanical deliveries is common history. Once the condition has begun it may be aggravated by increased intra-abdominal pressure, e.g. tumors, chronic cough and laborious occupations. Constipation and straining will also aggravate the condition. Prolapse of the uterus may be considered to occur in three degrees. The first degree involves descent of the uterus to a lower level than normal; but the cervix does not protrude at the vulva; it may or may not be accompanied with retrodisplacement. The second degree involves descent of the uterus still further until the cervix protrudes at the vulva and it is always accomplished with retrodisplacement of the uterus. In the third degree or procidentia, the whole uterus is expelled through the vulva, and the vagina is more or less completely inverted.

In long standing cases of second and third degree prolapse, certain secondary changes occur. The anterior vaginal wall loses its transverse folds and becomes smooth and looks more like a skin surface. The vaginal walls become thickened, hard and rigid. Ulceration is not uncommon in long standing cases, due to defective circulation, chronic irritation and friction. Infection may spread deeply, causing a



local peritonitis and the promotion of adhesions.

The condition of the perineal body is of importance in connection with prolapse. Three degrees of perineal laceration are usually described. The first degree involves half of the perineal body. The second degree extends up to, but does not include the sphincter ani muscle. In the third degree the sphincter ani has been severed, the anus is wholly or partly incompetent, and a portion of the rectal mucosa often protrudes. In rare cases perineal damage may not be found, but usually there is some degree of perineal. A partial or complete loss of tone of the perineal structures will predispose prolapse and incompetence is a distressing complication of prolapse.

Cystocele means a protrusion of the anterior vaginal wall, along with the base of the bladder and the urethra. The vaginal wall becomes stretched and smooth. The protrusion begins at the lowest part of the anterior vaginal wall and gradually comes to involve the upper or posterior section, finally pulling downwards on the cervix. The hernia of the bladder has occurred between the two pubococcygei muscles. Overstretching or tearing of these muscle fibers predisposes to cystocele. Commonly these patients have bladder friction disturbance, e.g. dribbling of urine when they laugh, cough or sneeze.

Rectocele is a protrusion of the lower part of the posterior vaginal wall which has carried with it a corresponding portion of the anterior rectal wall. This is the rarest of all the forms of prolapse. In procidentia the posterior vaginal wall usually separates itself from the rectal wall, so that the rectum does not actually take part in the prolapse. The loose arrangement of the cellular tissue between the vaginal and rectal walls allows of this stripping and separation of the two walls.

The symptoms of prolapse will necessarily depend upon the parts involved. Commonly there is a feeling of something coming down with or without a dragging

pain. This is aggravated by standing or walking. At times in procidentia patients, their chief complaint is that of a protruding mass which is an inconvenience. Pain is most common during the early stages. The menstrual function and reproduction are usually not impaired except in cases of procidentia. Leucorrhea may or may not be present. When a cystocele is present there is usually some bladder instability and frequency of micturition. The patient often has dribbling when she laughs, coughs or sneezes. A cystitis may be present and in some cases a hydronephrosis is found due to impairment in the normal drainage of the ureter. Partial loss of control of the sphincter ani is not uncommon. One of the most common clinical symptoms is that the patient is incapacitated from leading a normal life.

*Treatment of Prolapse:* There are three lines of treatment to be followed: (1) rest and general massage; (2) pessaries; (3) operative treatment.

Rest and general massage is applicable to young patients in the post-partum period. With proper rest in bed and massage treatments, and helpful postures one may expect quite good results at the end of three or four weeks' treatment. This method is not of any use in long standing cases.

Long standing prolapse cases can never be cured with pessaries. The pessary is used only to relieve symptoms and to check the natural tendency of the condition to increase. The pessary is used mostly in the first and second degree cases. The watch spring pessary is the one commonly used. This can only be used when there is sufficient retentive power in the vaginal walls to retain the pessary in position. One usually selects the largest size pessary which can be worn with comfort. If the pessary is too large it will serve only to further stretch the vaginal walls and reduce their tone, thus aggravating the condition. The Napier pessary is at times resorted to in cases of procidentia when there is some good reason for not operating.

*Operative Measures:* The following give the most satisfactory results. (1) vaginal hysterectomy, (2) perineorrhaphy: bladder fixation and amputation of the cervix. (3) Le Fort's operation. Removal of the uterus alone in those cases is usually useless. The main part whichever procedure is carried out is to make certain that the pelvic diaphragm has been properly repaired.

Chronic inversion of the uterus is a very rare condition but needs at least mention under the heading of displacements of the uterus. In cases it is the result of an acute puerperal inversion. In a rarer number of cases it is found in association with a tumor, commonly a submucous fibroid. The puerperal cases are usually more complete than those associated with tumors.

The mucous surface is much altered, the openings of the fallopian tubes are obscured. Ulceration is common. In long

standing cases the surface presenting is covered with squamous epithelium instead of columnar epithelium. The condition is usually accompanied with irregular hemorrhage. The differential diagnosis is made from (a) a large fibroid polypus, (2) carcinoma of cervix.

The treatment of chronic inversion of the uterus is carried out usually in one of two ways (a) repositor method, (b) operative method. The Aveling repositor may be tried in the beginning. This may be given a fair trial over a period of a few weeks, the position of the repositor being altered as required.

The operative measure of choice is vaginal hysterectomy in most cases of chronic inversion. If one is anxious to retain the uterus, the old method of incising the cuff and stitching up again after correcting the incision is well worth a trial; and it often gives quite good results.



# PYELITIS, URETERITIS AND CYSTITIS CYSTICA\*

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MORGAGNI in 1761 was the first to describe cysts of the mucous membrane of the renal pelvis and

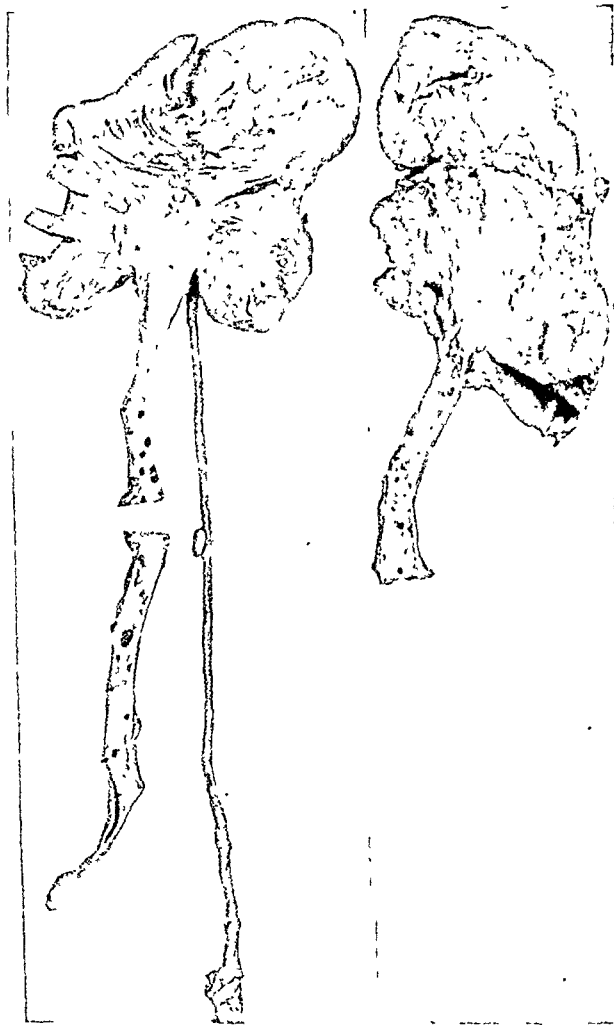


FIG. 1. Kidneys and ureters showing cysts.

ureter. He reported 2 cases, each showing a hydroureter and hydronephrosis, bilateral. Johnson, in 1816 reported a third case. Rayer, in 1837 and Rokitansky in 1861 reported cases and stated that cysts appear to be more frequent in the urinary passages than they are in or upon other excretory ducts. Virchow in 1863 compared the cysts to the mucous cysts of the vagina.

Litten in 1876 first studied these cysts microscopically and concluded that they were formed by an inflammatory blocking of the mucous glands and crypts of the mucous membrane, the retention of the secretion in these glands and crypts forming the cysts.

In 1889, Eve was convinced that they were parasitic in origin. He was supported by Morris, Bland-Sutton, Clark, Voelcker and Pisenti.

Von Brunn in 1893 described epithelial bodies (buds or sprouts) lying below the mucous membrane with an epithelial connection with the surface epithelium, and epithelial bodies showing no connection with the surface epithelium, which he designated as epithelial cell nests. These epithelial cell nests and buds are formed by the downward proliferation of the epithelium in the form of sprouts and their subsequent separation from the mucosal lining. He believed that this proliferation of epithelium was stimulated by inflammation.

Lubarsch in 1893 and Aschoff in 1894 confirmed Von Brunn's observations. Marchwald found ureteritis and cystitis cystica in a newborn, and maintained that an inflammatory process was not necessary to the formation of Von Brunn's epithelial buds or cell nests.

Stoerk, after a careful study of 13 cases of ureteritis and cystitis cystica, differed with Marchwald in that he considered the origin of the Von Brunn's cell nests to be inflammatory, and considered the cystic formation to be a secondary phenomenon.

Giani produced cystitis cystica experimentally in rabbits by the irritation of a foreign body in the bladder, and by curretting the vesical mucosa through a suprapubic cystotomy.

Morse in 1927 reviewed the literature and

\* From the Department of Pathology, University of Maryland.

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reported 3 cases from the Mayo Clinic with a careful microscopical study of the kidneys, ureters and bladder in 125 necropsies.

brown cysts measuring 3 mm. in diameter just above the trigon. The left ureter was dilated, measuring 10 to 15 mm. in diameter.

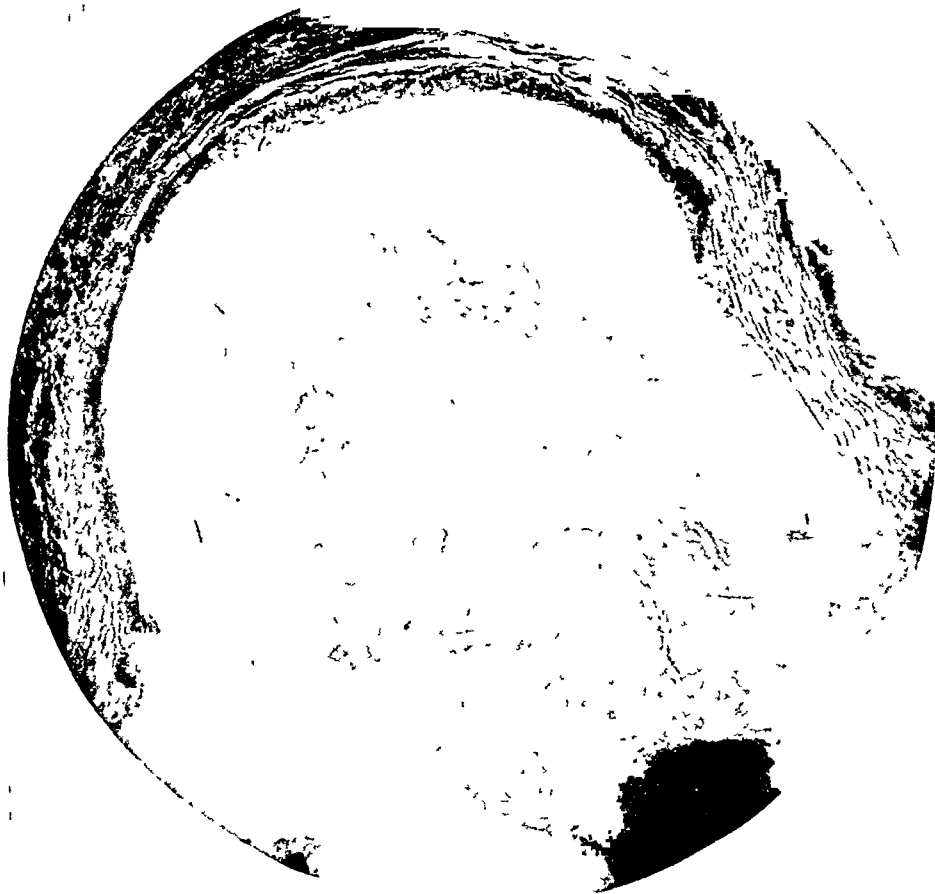


FIG. 2. Microphotograph of right ureter, showing cyst lined by cuboidal and columnar epithelial cells.

He found the so-called buds or cell nests of Von Brunn in 108 of the 125 cases or 86.4 per cent. In 63 of the 108 cases in which the epithelial buds or cell nests were present, inflammation was manifested by lymphatic infiltration or fibrous tissue proliferation.

Joelson in 1929 reported a case clinically diagnosed, associated with bilateral nephrolithiasis.

#### CASE REPORT

E. V. White, female, age fifty-eight years, Baltimore City Hospital, Autopsy No. 2604.

*Clinical Diagnosis:* chronic pyonephrosis and cystitis.

*Urinary Tract:* the bladder wall measuring 10 to 14 mm. in thickness with the mucosa being of a dark red color with 3 small yellowish

On section the wall measures 3 mm. in thickness, mucosa smooth and glistening with a number of bluish brown cysts measuring 1 to 3 mm. in diameter on its surface. There is a complete duplication of the right kidney pelvis and ureter, the ureter, draining the lower pelvis, is dilated, measuring 10 to 18 mm. in diameter. On section the wall is thickened, measuring 2 to 4 mm. with the mucosa dark red in color with a number of brown cysts on its surface, measuring 2 to 6 mm. in diameter. The upper right ureter on section shows no gross changes.

*Kidneys:* the capsule strips off with increased resistance, leaving a dark red granular surface. On section the cortex and medullary portion are thinned out with the architecture of the kidney poorly preserved.

The pelvis and calices are dilated and filled

with purulent urine, with the mucosa in the lower right pelvis dark red in color. Small brown cysts measuring 2 to 4 mm. in diameter are seen on the mucosa of the left kidney pelvis and lower right kidney pelvis.

**MICROSCOPICAL EXAMINATION.** *Kidneys:* sections show a thickening of the capsule due to adult connective tissue cells; just beneath the capsule in the cortical zone, collections of small round cells and polymorphonuclear leucocytes are seen. The capsule of Bowman shows a definite thickening due to adult fibrous connective tissue cells, some of which are stained as a pale pink homogeneous mass. The glomerular tufts in areas are stained as a pale pink homogeneous mass; in other areas they show the epithelial and endothelial cells poorly stained with the capillaries filled with leucocytes and red blood cells. The space between the capsule of Bowman and the glomerular tufts is filled with coagulated serum and fragmented cells. A number of tufts are replaced by fibrous connective tissue. In areas the glomerular tufts are seen to show their epithelial and endothelial cells well preserved. The tubules in many areas show the tubular epithelial cells poorly stained with fragmented cells and leucocytes free in the lumen. In areas, the tubular epithelial cells are distinct in cell outline with a well-stained nucleus. Between the tubules, the arterioles show moderate thickening of the tunica intima with a perivascular infiltration of small round cells, polymorphonuclear leucocytes and plasma cells. Sections from the pelvis show the surface epithelium to be swollen and finely granular in appearance. Just beneath the mucosa, a cyst is seen, lined with one or two layers of cuboidal epithelial cells well stained, with the lumen filled with coagulated sera, fragmented cells and a few polymorphonuclear leucocytes. In

the tunica propria and muscular layer, an infiltration of small round cells are seen with an occasional plasma cell.

*Ureter:* the muscular layer shows the circular fibers and longitudinal fibers well stained with a perivascular infiltration of lymphocytes. The tunica propria shows the elastic fibers poorly stained, with collections of small round cells between the elastic fibers. In several sections, collections of epithelial cells are seen cuboidal to columnar in type, surrounded by fibrous connective tissue cells, in areas cysts are seen lined with one or two layers of cuboidal epithelial cells with the lumen filled with coagulated sera, fragmented epithelial cells and a few polymorphonuclear leucocytes. The cysts are just beneath the surface epithelium which are well preserved. In several sections epithelial cell nests are seen communicating with the surface epithelium.

*Bladder:* Sections from the trigone show marked thickening of the muscular layer, due to fibrous connective tissue proliferation between the muscle fibers. The tunica propria shows marked infiltration of lymphoid cells and polymorphonuclear leucocytes. One cyst is seen which is lined by cuboidal epithelial cells, the lumen filled with fragmented cells and coagulated serum. The mucosa shows the transitional epithelial cells swollen and finely granular in appearance with necrotic material on its surface.

#### DISCUSSION

From the review of the literature and a study of this case, the author concludes that cystitis, ureteritis and pyelitis cystica are inflammatory in origin as described by Von Brunn in 1893. [For bibliography see author's reprints.]



# INFLUENZAL FASCITIS

## WITH A REPORT OF FIVE CASES\*

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SEVERAL years ago I observed a few cases in which a painful swelling appeared in the feet and heel cords following an attack of the grippe. During each succeeding winter I came across one or more similar cases and I finally became impressed with the fact that I was dealing with a definite complication of the grippe or influenza. This sequel of influenza undoubtedly occurs frequently, but has not attracted attention probably because its symptoms are usually mild, cause only moderate and temporary disability and no permanent defect. I am prompted to report my cases because I have found no reference to this lesion in any of the standard textbook articles on influenza. The following group of cases came under my observation during last spring and this year. All of them occurred during the months when the grippe was prevalent.

### CASE REPORTS

CASE I. Anna W. (Hospital No. A23-076), twenty-eight years old, was admitted to the service of Dr. Royal Whitman on May 6, 1927. Her chief complaint was pain in her feet. Three weeks previously she was ill with the grippe. She had a moderate rise of temperature and was confined to bed for two days. She was gradually recovering from the general depressing effects of the grippe when her feet became painful. Three days before her admission to the hospital the pain was very severe, and on the following day a swelling appeared in each foot making walking uncomfortable and difficult.

Upon her admission to the hospital she was unable to walk. She had a marked pallor, such as is common following the grippe. In the right foot there were two swollen areas, one on the inner and the other on the outer side of the ankle. The inner swelling was about 5 by 3 in. in area. It involved the astragalonavicular region and extended upward to above the malleolus. The swelling was not well defined

but faded gradually into normal tissue. The skin in the affected part was bright red, hot, glossy and very sensitive to pressure. Upon palpation it was evident that the subcutaneous tissues were swollen. There was a similar but less marked lesion on the outer side below the malleolus. The swelling did not extend to the sole of the foot but the plantar tissues were sensitive to pressure.

In the left foot there was a red, swollen, painful area on the inner side of the ankle, chiefly in the region of the attachment of the tibialis anticus tendon, and also a small painful swelling on the outer side of the ankle along the peroneus brevis.

The patient was kept in bed and given large doses of tolysin for her pain. Large quantities of fluids were given by mouth to counteract the general depletion. The temperature fluctuated between 100 and 102.8°F. Within five days her fever subsided and the local symptoms disappeared. On the eleventh day she was discharged cured. Two blood cultures were negative, the blood chemistry was normal, the urine showed no abnormal findings and the blood count was negative except for a moderate anemia.

This patient had, I believe, an acute inflammation of the subcutaneous fascial tissues, a fascitis, on the lateral surfaces of both feet and in the plantar region of the right foot, secondary to an influenza and probably due to the same bacterium.

CASE II. Edward G. twenty-eight years old was treated at the Hospital for Ruptured and Crippled (Case No. B1-919) on the service of Dr. Royal Whitman. He was admitted on April 19, 1927 complaining of pain in the back of the left knee, the soles of both feet and the right hand. These symptoms came on after an illness that probably was the grippe, but may have been a tonsillitis.

Examination upon admission to the hospital showed that the patient was in good general condition. There was a painful swelling in the plantar region of each foot. The skin was not red

\*Read before the Section on Orthopedic Surgery, New York Academy of Medicine, April 19, 1929.



from the inner border to well above the malleolus. It occupied the entire inner aspect of the ankle. The swelling was diffuse and faded gradually into surrounding normal tissue. On the outer aspect of the ankle the swelling was similar, but less extensive. The skin was bright red and glossy. There was also a moderate swelling about the lower part of the heel cord. The skin here was not red. The ankle motions were restricted by the pain in the swollen areas, but the ankle joint itself was not involved. The swollen areas were very sensitive even to light pressure. The tissues over the left sternomastoid muscle, the right great trochanter and the lumbosacral joint were tender to touch. There was no discernible swelling or redness of the skin in these latter areas. Tolysin, aspirin and even morphine gave little relief.

On the following day a red, hot, very painful swelling was found on the inner side of the left foot similar in appearance and distribution to that on the right foot. The tissues about the left heel cord were also swollen, sensitive to pressure and painful during motions of the foot, especially dorsiflexion. A painful spot appeared on the outer side of the left thigh slightly below and behind the great trochanter. Application of heat externally with a baking lamp increased the pain. As the symptoms were becoming worse and the pain was intense, it was determined to remove her to a hospital for observation, and she was admitted to my service at the Hospital for Joint Diseases. X-ray pictures of both feet and a blood count were negative. It occurred to me to apply wet dressings of a boric acid solution to the swollen parts. These were changed every hour, day and night and were kept continually covered with oiled silk. This procedure worked like a charm. The pain immediately subsided. The swelling, redness and sensitiveness rapidly diminished. A slight fever persisted for about a week. On the third day after admission to the hospital the tissues about the sternomastoid and the attachment of the left adductor muscles to the pelvis became painful and sensitive to touch. There was no redness or swelling in these areas. These symptoms lasted only several days. The urine was negative except for a trace of albumin. A blood culture was negative after seventy-two hours of incubation.

The patient was discharged on the eighth day after her admission, because she had to attend the funeral of her mother. When she

left the hospital there were no symptoms in either lower limb, but her temperature was 99.5°F., indicating that she was not entirely well. Two days later she returned on account of a slight relapse of the swelling, redness and pain in her feet. The application of wet boric acid dressings gave immediate relief. In five days her temperature was normal and all symptoms disappeared. She left the hospital and has remained well since.

CASE V. Mr. B. came to my office complaining of a painful swelling on the front of his left leg. This extended upward from the ankle for about 4 in. The symptoms which came on about a week after a mild cold or grippe during the recent epidemic of influenza in New York, had existed for about five days when he consulted me, and they were getting worse.

Upon examination I found a diffuse swelling on the front of the lower part of the leg. There was no redness, but there was slight local heat and marked sensitiveness to pressure. An x-ray picture was negative. He was immediately urged to rest in bed and apply boric acid dressings. He did so and obtained complete relief and a cure in about six days.

The cases described have many common characteristics. All of them were adults and were ill when the grippe was prevalent in the city. In all the patients, including those observed prior to 1927 and not reported because I had not kept a record of them, the symptoms came on from four to seven days after an attack of the grippe. The grippe had not been of a severe nature in any of the patients.

The local lesion occurs most often in the feet, but may occur in the subcutaneous fascial tissues of any part of the body. The characteristic clinical appearance is a painful swelling in the sole of the foot and around the heel cord, that is, in the plantar fascia and the areolar tissues about the tendo Achillis. Elsewhere it occurs in the neighborhood of tendons and subtendinous bursae. When the lesion is in the lower limb walking is difficult or impossible, and the pain is increased by any movement of the limb. Pressure upon the swollen area causes pain. The skin is usually white and shiny. When the inflammation involves the skin, it is red, hot,



glossy and very sensitive to pressure. The essential pathologic change is, I believe, an inflammation of the subcutaneous fascial tissues. Since the lesion has been found only in patients who have or are just getting over an attack of the grippe or influenza, it appears to me logical to at least assume that it is due to an invasion of the fascial structure by the bacterium of influenza or its toxins. I have had no opportunity to obtain bacteriological proof of this conclusion which I, consequently, base on clinical evidence only. As the inflammation of the subcutaneous tissues is a complication of influenza, I believe that the term *influenzal fascitis* is appropriate since it describes the pathology of the lesion and its likely etiology.

The treatment, from my experience in the last two cases, is fortunately simple. It consists of rest in bed and the application of wet dressings to the inflamed parts. The inflammation subsides in a few days and leaves no residual defects. From the relapse of the painful swelling in some of the cases it is advisable to continue rest in bed for at least a week after freedom from all symptoms.

#### DISCUSSION

DR. A. DEF. SMITH: I would like to know why Dr. Kleinberg is so certain that this inflammation is confined to the fascia and subcutaneous tissues. There are other tissues in the same regions, tendon sheaths, muscles, joints and periosteum, and I don't see why they may not be involved as well as the fascia. There is not any pathological proof, of course, that it is the fascia.

DR. RALPH C. KAHLE: I have had the good fortune of seeing several of these cases of Dr. Kleinberg's and have had the opportunity of observing a case of my own, a man thirty-six years old, with a typical history of four days after the initial grippe developing symptoms with swelling of the inner side of the ankle which subsided after rest and applications of warm boric acid solution.

This afternoon at the Cornell Clinic I saw another case with a similar history, six days after the grippe, with a swelling on the inner side of the ankle. It was just as Dr. Kleinberg described, hard, tender, reddened, etc. There was nothing present to make any one think the lymphatics were involved nor were the signs of venous thrombosis. For want of another term, I called it the same as Dr. Kleinberg and used the same treatment as in the other case.

DR. CHARLTON WALLACE: How can one tell the difference between fascitis and cellulitis?

DR. SIGMUND EPSTEIN: The history of grippe is very often erroneous. A case of painful foot and calf was seen yesterday; three doctors said that he had grippe: a severe phlebitis of the calf branches was the real diagnosis. His troubles had lasted five weeks. I find similar swellings of the foot, ankle and tendo Achilles are very common. Some of them are red. They consist of subcutaneous indurations and are infectious in origin. The British call them *fibrositis*; the dermatologists call them *erythema nodosum*.

DR. KLEINBERG, closing: I am sure that the muscles in cases of *influenzal fascitis* are not involved. In most of the cases the swelling is limited to the sole of the foot and there is no pain on contraction of any of the muscles of the foot or leg except when the motion causes tension on the swollen area. In several cases the swelling extended over the external malleolus and it is often in the region of the heel cord where there are no muscles. When one considers the composite picture of *influenzal fascitis*, one readily concludes that there is no involvement of the muscles. The inflammation is usually limited to the subcutaneous tissues; occasionally there is involvement of the skin. So far as cellulitis is concerned there is no difficulty in differentiating fascitis from the ordinary type of cellulitis. In the latter condition, there is an enlargement of the glands, a lymphangitis and a severe toxemia. These are absent in fascitis. Periostitis can be excluded, first, by the fact that the x-ray pictures are negative and secondly, by the fact that pain upon pressure is present even to light touch when manifestly there is no irritation of the periosteum. I have not seen any untoward sequelae following *influenzal fascitis*.

# GLUCOSE IN THE TREATMENT OF TOXEMIAS OF PREGNANCY\*

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A LIST of the various theories of the etiology of the toxemias of pregnancy would consume more space than is allotted for this entire paper. An enumeration of the many procedures employed in the treatment of these conditions would be equally voluminous. We will, therefore, limit our discussion to a consideration of carbohydrate metabolism in these toxic conditions, and some observations on the phenomena encountered in the administration of glucose (or dextrose) in the treatment thereof.

The most common forms of toxemia of pregnancy are the vomiting of the early months of gestation, culminating in hyperemesis gravidarum, and the disturbances of the latter months, terminating in eclampsia.

The contributing factors in the etiology of the early toxemias are many.

The immediate cause of such disturbance is the presence in the blood stream of substances acting as toxic agents exerting a deleterious influence upon metabolism, with the resultant digestive disorders.

In the average case, the reserve forces are sufficient to adjust these difficulties in a few weeks, so that the patient will continue her pregnancy with a good degree of comfort and well-being.

In some few cases the distributing element is of such a severe nature that the maternal organism is not able to successfully combat these evil forces, the nausea and vomiting become more and more severe, until nothing is retained in the stomach.

This extreme condition, fortunately, is not so common as formerly, due largely to better supervision of the patient and more energetic efforts to correct the condi-

tion producing the ordinary vomiting of pregnancy. Few cases indeed need progress to the state of hyperemesis gravidarum, if proper attention is paid to the earlier and milder forms of vomiting.

It has been shown by Paul Titus<sup>1</sup> and others that in practically all of these cases, whether mild or severe, a marked carbohydrate disturbance is present. As soon as pregnancy is established, the carbohydrate needs of the mother are markedly increased. When the endocrines governing metabolism are able to care for this sudden need, there is no marked disturbance; when, however, the requirements develop more rapidly than the metabolic hormones are able to adjust themselves to the new conditions, digestive disturbances follow.

The developing placenta requires a great amount of glycogen,<sup>2</sup> and the liver is called upon for an increased supply. In multiple pregnancy the placental area and volume being greater, a still larger demand is made upon the store of glycogen and a greater tax is put upon the endocrines. If the metabolic forces are not able to supply the liver with sufficient sugar to insure an adequate glycogen reserve, hepatic degeneration results, and glycogen production falls, even below its ordinary level. Thus a vicious circle is thereby established. The more the liver is damaged, the less glycogen is produced, and the more the glycogen reserve is depleted, the more liver damage ensues.<sup>3</sup>

It is probably this sudden need that first throws the endocrines out of balance, and once disorganized, they in turn fall below ordinary efficiency.<sup>4</sup>

Before this phenomenon was so well understood, the usual method of treatment of hyperemesis gravidarum was an early

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emptying of the uterus. This method of necessity sacrificed the fetus and frequently the mother, since by the time the disturbance progressed to the stage of actual hyperemesis, the maternal condition was such that the shock of abortion was sufficient to produce a fatal issue for the mother. The problem in the treatment of this condition, therefore, was to supply glucose to the maternal organism in such a form and in sufficient quantities, that the liver would have a chance to recuperate, the endocrines have opportunity to adjust their functions to the new requirements, the maternal organism would be adequately nourished, the dehydration combated, and the fetal needs met.

The fact that the employment of such a system of treatment for hyperemesis is successful, both regarding mother and child, making therapeutic abortion seldom necessary, seems to prove its efficiency.

While various modifications in the technique are recommended by different operators, yet the glucose treatment of hyperemesis has been developed to a point where the essential features form a common basis for these methods.<sup>5</sup>

The following case is typical of the condition under consideration and the treatment employed, and is here reported as an illustration of the usual results obtained by us in hyperemesis:

**CASE I.** Mrs. M. S. B., para II, aged thirty-seven, was referred to me on June 9, 1928. Examination showed patient to be dehydrated, dry, parched skin, heart rate 130, temperature 100, blood pressure 120-85, urine negative, for sugar, albumin, casts or pus. She gave a history of having her last menstrual period 3 months previously (March 5), of being able to retain practically nothing by stomach for the past week. Complained of severe epigastric pain, sleeplessness, diplopia, pronounced weakness and prostration.

Vaginal examination revealed a much larger uterus than would be found in a 3 months' pregnancy.

*Treatment.* One ampule of corpus leutea was immediately given intravenously, without any beneficial results.

She was removed to the Kentucky Baptist Hospital. Everything by mouth was discontinued, 1000 c.c. of 5 per cent glucose in 1 per cent. saline were given intravenously, the administration being completed in forty-five minutes. This was repeated daily for five days, when the urinary output reached the amount of in-take; 4 oz. of 10 per cent glucose containing 60 grains of potassium bromide were instilled into the rectum every four hours.

The nausea and vomiting stopped immediately after the first injection of glucose: the abdominal pain ceased with fifteen minutes; neither of these symptoms recurred.

On the third day some vaginal bleeding and cramps occurred, but subsided two days later. The diplopia disappeared about the seventh day. The pulse and temperature returned to normal on the third day.

From the third day fluids were given by mouth, at which time the rectal instillations were discontinued, and elixir bromidum and elixir luminal, each drams 1, were given by mouth three times daily. After the fifth injection of glucose the temperature went up to 102 and the pulse to 120, remaining thus for several hours, then returning to normal. Soft diet was given after the fifth day, and regular diet on the seventh.

The patient left the hospital on the tenth day in good condition, with no recurrence of symptoms.

As pregnancy progressed, hydramnios developed so markedly that no diagnosis of position or presentation was possible by auscultation or palpation. On September 5, twin pregnancy was diagnosed by x-ray, showing about seven months' pregnancy. She was readmitted to the hospital on October 10, because of discomfort due to abdominal enlargement.

By November 1, the hydramnios had become so marked that the respiratory and circulatory embarrassment demanded interruption of pregnancy.

The babies were both female, weighed 4 lbs. 6 oz., and 5 lbs. 6 oz., respectively, apparently single-ovum twins, well-developed and healthy. Mother and babies left the hospital in good condition, and today, more than six months later, are all thriving and well.

Another interesting case was one of hyperemesis in an unmarried primipara, who was also suffering from an acute nephritis due probably to the taking of

large amounts of turpentine with abortive intent.

CASE II. This patient, R. C., para 1, fourteen years old, four months' pregnant, was brought into the Louisville City Hospital in a semi-comatose condition. Her history showed she had taken 1 oz. of turpentine several times in the three weeks preceding admission.

She was given ten administrations of glucose without relief of the emesis.

A therapeutic abortion was done twenty-two days after admission, after which vomiting ceased, and patient recovered.

The blood chemistry taken at intervals during this period showed: non-protein nitrogen, 75, 93.6, 194.8, 113, 85.5, 88.2; urea, 38, 70, 88.2, 70, 40, 46; creatinine, 8, 7.5, 10, 9, 6, 4.8; plasma bicarb., 73, 150, 140, 130. An initial blood-sugar reading showed 153.

It will be seen that the blood chemistry in this case showed improvement under glucose, even though the vomiting was not controlled thereby. We have seen other such cases showing severe vomiting, accompanied by acute nephritis, in which glucose did not relieve the vomiting. In all cases of hyperemesis, however, unaccompanied by an acute nephritic groundwork, glucose has been eminently successful.

The 2 cases above reported illustrate the results obtained by glucose in hyperemesis, first, when the hyperemesis has for its primary basis a carbohydrate deficiency due to metabolic upset, and, as in the latter instance, where the vomiting is incidental and the basic condition is an acute damage to the other organs, especially the kidneys.

Regarding the rôle that carbohydrate deficiency plays in the late toxemias of pregnancy, much valuable work has been done recently, and there is a strong probability that out of this will soon be developed more definite knowledge of the relationship of carbohydrate metabolism to eclamptic conditions.

Paul Titus<sup>6</sup> has brought out some very pertinent points in this connection, one of the most striking of these being his

findings in blood-sugar levels during the acute eclamptic state. He has shown that the convulsions are immediately preceded by a sudden marked drop in blood-sugar; that the hypoglycemia in eclampsia is relative and not absolute: that is, that the average blood-sugar level in this condition is not necessarily lowered, but drops markedly only in relation to a convulsion. He further suggests:

The chief difference between the clinical symptoms of the toxicoses of early and late pregnancy is due to the fact that the former is a slow, and the latter an acute, rapidly progressing process. In early pregnancy the fetal requirements are less and the demands are more gradual, so that the glycogen depletion of hyperemesis rarely is swift enough to cause convulsions. Occasionally, however, we see that fulminating process termed acute yellow atrophy of the liver which is pathologically identical with hyperemesis but is so acute that eclampsia-like convulsions usually occur.<sup>7</sup>

In our own experience there would seem to be some evidence of such a relationship as Titus describes. The chief clinical differences in the early and late toxicoses, as we have observed them, are the marked elevation of blood-pressure, albuminuria, and convulsions, present in eclampsia, while absent or negligible in hyperemesis. In eclampsia we have also failed to get from the administration of glucose the phenomenal benefits obtained in the treatment of hyperemesis. As to liver pathology, we have not found in all fatal cases of eclampsia the typical acute yellow atrophy lesions of this fulminating toxemia of early pregnancy.<sup>8</sup> In view of the above variations, the question arises if the differences encountered in early and late toxemias would not have to be accounted for by a more basic factor than the mere element of rapidity of development. For example, would the rate of the process account for the elevation of blood-pressure in eclampsia, while normal in hyperemesis? It would seem to the writer that the severe manifestations of hyperemesis are more nearly the result of glycogen depletion,

TABLE I

Name	Para.	Age	Diagnosis	Glucose given		Blood-pressure before glucose administration	Blood-pressure 1 hour later	Blood-sugar before glucose administration	Blood-sugar 1 hour later
				c.c.	Per cent				
L. P.	v	29	Eclampsia	500 500	10 10	205/120 185/120	200/110 185/110		
J. D.	vi	35	Eclampsia	450	10	185/120	175/100	97.5	166.
E. P.	i		Eclampsia	500	20	148/98	142/90		
H. M.	vi	38	Eclampsia	500 500	20 20	138/90 170/90	140/80 150/80		
M. P.	iii	27	Eclampsia	500 500 400	20 20 20	230/110 150/100 199/106	210/106 140/100 196/103	111	200.
E. G.	i	17	Eclampsia	500	12	170/110	130/80		
K. W.	i	21	Eclampsia	500	20	152/105	150/105	111	112
A. J.	x	31	Eclampsia	250 200 500	20 20 20	180/140 184/124 190/125	140/105 174/120 170/115	80	88.3

The average show a drop in blood-pressure of 12 points in the systolic and 9 points in the diastolic pressure. Blood-sugar shows a rise of 40.5 points.

while the carbohydrate disturbances of eclampsia are more directly the result of the toxemia, and occur as a part of the general metabolic upset; or in other words, an incidental occurrence in eclampsia rather than the primary manifestation as in the early toxemia.

We have recently been interested in the influence of intravenous glucose upon blood pressure and blood-sugar in eclampsia. In the accompanying table, it will be seen that both the systolic and diastolic pressure were lowered in practically every instance and no elevation in any case.

The average for all cases showed a lowering of 12 mm. for the systolic and 9 mm. for the diastolic. The blood-sugar, however, was elevated in each instance, the average being 40.5 points. In each of these cases, blood-pressure readings were taken at frequent intervals after the discontinuance of the glucose administration. Before the glucose was given the reading was 180/140; 15 minutes after the completion of administration it was 140/100; after 25 minutes, 160/100; after 35 minutes 155/110; after 45 minutes 150/100; one hour after discontinuance

the reading was 140/105. This patient passed 1000 c.c. of urine within one and one-half hours after glucose administration. We have noticed in practically all eclamptic cases that the urine is more copious after glucose administration. This may account in part for the fact that the blood-pressure is lowered by the glucose, even though the blood volume is temporarily increased. Yet we believe it would not wholly account for this phenomenon. The blood-pressure is lowered before the kidneys would have time to react to this extent. There must be a neutralizing of the vaso-constrictor effect of the toxin, whatever that toxin may be.

The writer would hesitate to add even one more theory to the already long list of speculations regarding toxic action in eclampsia, but in an earnest effort to account for the various phenomena observed in the treatment of this condition, one naturally seeks to find some plausible explanation, and a number of observations already accepted as authentic would, to our mind, offer a possible reason for certain clinical results in the employment of glucose.

In the first place, blood-sugar falls rather suddenly immediately preceding a convulsion. Then the eclamptic convulsion is very similar to the manifestations seen in shock from an over-dose of insulin.<sup>9</sup> Also, blood-pressure is lowered by glucose administration, even though blood-volume is temporarily increased. The use of glucose, too, seems to have a marked influence in lessening the number of convulsions. Therefore, it would seem reasonable to conclude that the toxin of eclampsia stimulates the production of insulin, and that the convulsions are precipitated, in part at least, by the sudden appearance in the blood stream of an overload of insulin. If this be true, the beneficial influence of glucose could be accounted for in part by its neutralizing effect upon this insulin.

As to the amount of glucose used, it will be seen by the accompanying table, 500 c.c. of a 20 per cent solution were usually employed. In instances where we have used 1000 c.c. of a 10 per cent solution, results were not markedly different.

As to the amount of glucose which may be tolerated by toxic patients some very interesting work has been recently done by Dr. G. A. Hendon.<sup>10</sup> He uses a continuous flow of glucose solution which he styles "venoclysis." It has been the writer's privilege to observe a number of cases treated by this method, and the results obtained have been spectacular. This procedure is as yet in a more or less experimental stage, but enough work has already been done to demonstrate some very interesting facts regarding the intravenous administration of glucose.

To Dr. Rudolph Matas probably belongs the credit of first calling attention to this method. In June, 1923, he reads a paper before the American Surgical Section on "Continuous Intravenous Drip."<sup>11</sup> The method proposed by Matas did not come into popular use, however, probably due to the following difficulties: (1), inability to keep the solution at an even

temperature; (2), inconvenience to the patient, the arm having to be held immobile during the administration; (3), the clogging of the needle or canula by the solutions.

These difficulties have apparently been obviated by the technic and apparatus employed by Hendon. He has used this form of administration in something over 100 cases. A 5 to 10 per cent solution of anhydrous glucose in freshly distilled water is the concentration usually employed. The average amount given an adult is 4000 c.c., or one gallon, every twenty-four hours. The average duration of the continuous administration in all his cases is about seven days, one patient, a gastric ulcer case, receiving 5000 c.c. of a 5 per cent daily for sixteen days.

In none of these patients has there been any untoward results; there have been no symptoms of hyperinsulinism (a probable complication suggested by Thalheimer),<sup>12</sup> except in two hyperemesis cases where insulin was given with the glucose. The two patients showed evidence of slight insulin poisoning, which disappeared immediately upon discontinuing the insulin, the glucose being continued.

The concentration of the solution employed has been determined by the point at which sugar appears in the urine. If glycosuria appeared, the concentration is reduced. Practically all of them tolerate a 5 per cent strength, and many of them 10 per cent without glycosuria. In those cases where blood-sugar determination has been done, the average level has been about 150, the highest reading being 169. In this case, however, no sugar showed in the urine.

One reason why such apparently large quantities can be taken is that no sudden load is put upon the powers of assimilation, or upon the circulatory function. The usual rate of continuous administration is one drop per heart beat.

Woodyatt, Sansum and Wilder<sup>13</sup> claim that a normal individual can assimilate without glycosuria 0.9 gm. of glucose

per k. of body weight per hour. In other words, a man weighing 150 lbs. would take care of 2.5 lbs. per day.

In Hendon's series the patients received from 1 to 2 lbs. per day.

The cases in which this method has been employed include those of severe toxemia, septicemia and conditions in which oral feeding has, for any reason, been impracticable. These patients require no water or food by mouth during the administration.

A number of these cases have been those of desperate hyperemesis gravidarum, in which the use of glucose by the usual methods was unsuccessful, while with the continuous drip the condition was completely relieved.

The essential features of the apparatus used are two thermos bottles of 1000 c.c. capacity each, suspended in a wire frame and attached to a Y-tube, which is in turn connected to a Murphy drip tube; from this a single rubber tube leads to a gold-plated silver canula. This canula is inserted through a phlebotomy opening into a vein just above the bend in the elbow. The vein is ligated distal to the insertion, and a ligature of umbilical tape is passed around the canula in the vein, held in situ by a shoulder on the canula. The wound is closed and a sterile dressing applied. The rubber tubing is fixed to the arm by strips of adhesive, permitting the patient to move the arm at will during the administration. The use of two thermos bottles permits the employment of one while the other is being filled. The thermos feature keeps the solution at a constant temperature.

It is noteworthy that in no case so treated has there been any reaction or other ill effects of the glucose administration, and further that the desired results have been obtained in every instance.

If the further results of this method prove as desirable as those already obtained, it will broaden the field of usefulness of glucose therapy, especially in the treatment of those severe toxemias of early pregnancy where other less intensive methods fail.

#### SUMMARY

From our observations enumerated herein, the following points might be summarized:

1. In the early toxemias of pregnancy, where the disturbance is of metabolic origin, the employment of glucose is probably our best single therapeutic agent.
2. In those early toxemias of renal origin, glucose is of value as a supportive and detoxicant, but does not relieve the hyperemesis as completely as in the toxemias of primary carbohydrate deficiency.
3. In the late toxemias, glucose is effective in lowering blood-pressure, neutralizing the toxin and lessening the number of eclamptic convulsions.
4. Recent experiments with the continuous drip method of the intravenous use of glucose tend to show that larger quantities of this agent can be used, and with more beneficial results, than was formerly supposed.

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# INTRAPERITONEAL INFUSION & AUTOTRANSFUSION

IN ABDOMINAL SURGERY\*

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THE importance of an adequate supply of fluids after operation is generally recognized even by surgeons who still dehydrate their patients by preoperative catharsis and restriction of water intake. The use of the Murphy drip, hypodermoclysis and intravenous infusions is almost universal. In all, or nearly all clean abdominal operations these procedures are unnecessary annoyances to the patient, the surgeon and the nurses.

As shown by Wegner, absorption from the peritoneal cavity is so rapid that the injection of potassium cyanide causes death almost instantly, just as if it were injected into the blood stream. Normal salt solution is absorbed directly into the blood stream. Dandy and Rowntree<sup>1</sup> proved this by injecting a solution containing phenolsulphonephthalein as an indicator. The dye appeared in the urine in six minutes and in the lymph only after thirty-seven minutes. In an hour, 56.4 per cent of the dye was regained from the urine, while less than 0.1 per cent appeared in the thoracic duct. Clinical confirmation of this work is described below.

Why not utilize the peritoneum to furnish the patient with a continuous supply of water during the time when he needs it most? There is no limitation to the amount that can be absorbed except the capacity of the abdominal cavity. The technic is simple. After the last peritoneal suture has been inserted and before it has been tied, a catheter or small enterostomy tube is inserted and normal saline solution at 100° or 104°F. is poured by means of a funnel until the solution begins to run out around the tube. In the average case about 1 liter is used but after the removal of a large tumor, much larger amounts are taken.

The benefit of this procedure is twofold. It immediately overcomes the chilling of the peritoneum which is unavoidable in any extensive operation and it assures a constant intake of water for the six or eight hours during which it is needed most. Whether it prevents adhesions is debatable. The striking absence of postoperative thirst would justify the use of the method regardless of the general benefit to the patient. Since adopting this method, we have discontinued the use of the Murphy drip except where the intraperitoneal infusion is contraindicated by the presence of pus or by drainage of the wound.

The power of the peritoneum to absorb fluids as shown by animal experiment has already been mentioned. Clinically, we have checked it by the following experiment:

To 1 liter of normal saline solution, we have added 1 c.c. of standard solution of phenolsulphonephthalein solution. The urine has been collected by catheter at intervals of one, two and six hours and quantitatively tested. The average percentages of excretion are:

Hours	Per Cent
1	14
2	37
6	59

Since these figures are dependent not only on the rate of absorption but on the rate of renal excretion, it is obvious that a considerable degree of absorption begins immediately and the greater part of the solution has entered the circulation during the first six hours.

## INTRAPERITONEAL AUTOTRANSFUSION

Many reports have appeared in recent years of the intravenous infusion of citrated blood taken from the abdomen,

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especially in cases of ectopic pregnancy. This is a logical procedure, especially when the abdomen is full of fresh unclotted blood from recent hemorrhage, whether from ectopic pregnancy or ruptured liver or spleen. It is much simpler and apparently as effective to citrate the blood and return it to the peritoneal cavity with the routine saline at the conclusion of the operation. We have done this particularly when hysterectomy was performed for bleeding fibroids. These patients are frequently anemic and it is desirable to save them from further loss of blood. Especially when dense adhesions must be separated, a good deal of bleeding is often unavoidable. Lesage<sup>2</sup> found in experimental animals that untreated blood is absorbed rapidly after three hours. Bizzozero and Golgi,<sup>3</sup> using defibrinated blood, found an increase in the number of red cells twenty minutes after injection. The maximum increase came after about two days. Hertzler<sup>4</sup> says, "The absorption of non-coagulated blood seems to be similar to the absorption of isotonic solutions in general."

By means of the ordinary Pool suction tube, free blood is aspirated into a sterile bottle containing citrate solution. A basin containing citrated saline solution is also placed conveniently so that an assistant can rinse in it each sponge as it becomes soaked with blood. At the conclusion of the operation, the citrated blood in the bottle and the saline-blood mixture in the basin are strained through gauze and warm saline is added to bring the volume up to 1000 c.c. and the temperature up to 100°F. The mixture is then introduced as in the routine saline infusion previously described. We have been doing this for

nearly three years and have never seen the slightest ill effect. Many pediatricists have used the intraperitoneal route in administering citrated blood to infants, apparently with complete satisfaction. This seems to answer the theoretical objection that blood is a foreign body in the peritoneal cavity.

When intravenous autotransfusion is used every precaution is taken to prevent breaking up the red cells. This is emphasized by Farrar,<sup>5</sup> who says: "Care was taken not to stir or shake the blood to avoid injury to the red cells." Clots must be eliminated. An extra assistant is necessary.

In the intraperitoneal method, a few clots do no harm. Ruptured red cells are absorbed and the hemoglobin utilized. The blood-soaked sponges may be squeezed and even rinsed out in the citrate solution, so that the greatest possible salvage is effected. No extra assistant is required. If no suction is available, the greater part of the blood can still be saved by sponging or ladling it from the abdomen.

In the event of severe hemorrhage into the abdominal cavity, whether it occurs before or during operation, it is not good surgery to throw away the blood. This method of returning it to the patient is simple, safe and effective. It is a conservative measure which is worthy of more general use.

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# THE PORGES-POLLATSCHEK SKIN TEST FOR PREGNANCY\*

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A SIMPLE and yet reliable skin test would be highly desirable and of vast importance in the diagnosis of early pregnancy. The importance of such a test is particularly obvious in post partum cases where a slight increase in the size of the uterus occurring together with a lactation amenorrhea must be ruled out as signs of pregnancy. Its value is equally apparent in the diagnosis of a gestation at the premenopausal age. In cases of young girls of irregular menses and also of recognized social status, a skin test for pregnancy would be invaluable since it would eliminate a highly embarrassing and perhaps a presumptuous pelvic examination. Even in legal cases wherein the history must be disregarded and pregnancy diagnosed early, such a test would be of vast assistance and, last but not least, in instances where the physician is called in to differentiate between an ectopic and some non-surgical condition.

The Ascheim-Zondeck test for pregnancy might well be relied upon in all such conditions except in an ectopic gestation; it is very reliable since it gives 95 per cent to 98 per cent correct results in the hands of an experienced man. However, one must have facilities for keeping mice. This is a very difficult task for the following reasons: they must be virgins of a certain weight and age, and at that age, sex is hard to determine; occasionally they kill each other; frequently they die before injection; many die from meningitis or from toxic urine. Moreover the urine of a patient receiving antiluetic treatment kills the mice within forty-eight hours. And finally, it takes almost a week to make a diagnosis, thus rendering this task practically useless in ectopic gestation.

In the Vienna letter to the *Journal of the American Medical Association* on Aug-

ust 17, 1929, a simple and yet reliable skin test eliminating these objections was briefly mentioned. Dr. Otto Pollatschek and Dr. R. Porges of Vienna were injecting 0.2 c.c. of the hormone of the anterior lobe of the hypophysis intracutaneously. "If the woman is not pregnant, a distinct red circle, about an inch in diameter, is formed after a few hours at the sight of the injection, and remains visible for twenty-four to thirty-six hours. In pregnant women, there is no reaction." This was explained as a specific skin reaction which was an entirely new observation for hormones, and as analogous to the Schick, Dick and Pirquet test for infectious toxins.

Not convinced by the explanation of the mechanism involved, but interested in checking up the results of the European investigators, I obtained permission from the heads of the various departments of the Kings County Hospital to conduct this experiment. The only preparation of anterior pituitary hormone available in the United States was antuitrin. Later I was able to procure prolan, the preparation that the Viennese physicians used.

In order to avoid drawing unwarranted conclusions, I chose a series of over 500 consecutive cases. Of this original number, 50 were excluded because of failure to return for a reading. I discarded an additional 100 in order to thoroughly familiarize myself with the procedure and to eliminate trauma as a possible factor. Thirty more cases were thrown out due to the intense pigmentation of the skin. However, the greatest factor against this test was the indefiniteness of the results, which made us disregard 150 cases. The skin reactions were of such a nature, in this latter group, that 2 or 3 observers could not agree on the readings. Of the total number of 524 cases, only 184 remained, which are tabulated as follows:

\* Submitted for publication, January 21, 1930.

TABLE I

Condition	Total Number (Antuitrin)	Results
Males.....	6	5+, 1—
Menopause.....	1	1—
Postpartum.....	8	5+, 3+
Menstruating.....	1	1+
Pregnant.....	22	5+, 17—
Non-pregnant.....	28	18+, 10—
Inevitable abortion.....	1	1—
Ruptured ectopic.....	1	1—
Incomplete abortion.....	1	1±
	69	

TABLE II

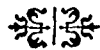
Condition	Total Number (Prolan)	Results
Males.....	4	4+
Menopause.....	11	1+, 9—, 1±
Postpartum.....	13	3+, 7—, 3±
Menstruating.....	5	3+, 2—
Pregnant.....	36	12+, 24—
Non-pregnant.....	46	28+, 10—, 8±
	115	

The results obtained by the writer as just indicated lead to only one obvious conclusion: namely, that the so-called

Porges-Pollatschek skin test for pregnancy is neither definite nor reliable. Subsequently, the writer's findings were confirmed by the very authors of this so-called test, for towards the latter part of the investigation, a communication was received from Dr. Porges himself, wherein he admitted that as his series of tests increased his percentage of error ran as high as 18 per cent. Obviously, this was quite a radical departure from the earlier assertions regarding the absolute reliability of this test, for originally it was claimed that the test had been proved correct in all but one instance, that of a woman who had a hypophyseal tumor.<sup>1</sup>

In conclusion, the writer would like to express his gratitude for the kind assistance and cooperation rendered him by Drs. Philip Smith and Raphael Kurzrock of Manhattan and Dr. M. Walzer of Brooklyn, but for whose helpful suggestions many of the obstacles which confronted him could hardly have been overcome.

<sup>1</sup> Further confirmation of the writer's findings has since appeared in the *Zentralbl. f. Gynak.*, 53 Jahrg. 16, Nov. 1929, No. 46, p. 1920, wherein Dr. Alfred Deutsch of Vienna, after a series of similar experiments, announced conclusions coinciding with those of the writer.



# THE SURGICAL TREATMENT OF UTERINE FIBROMYOMA\*

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UTERINE fibromyoma is the most common nonmalignant new growth occurring in the human body and relatively speaking, constitutes the most frequent pathological condition the gynecologist is called upon to treat. In a personal series of 416 pelvic operations taken chronologically, the writer found the presence of the ordinary lobular levicellular fibromyoma of the uterus in 68 cases or 16.3 per cent. All the patients were white women with the exception of one. These findings are considerably higher than those of Hofmeier and Essen Moler who estimate that they constitute from 4.3 to 4.7 per cent of all gynecological conditions. However, they are within fair keeping with those of Lynch's<sup>1</sup> and Frank's<sup>2</sup> most thorough accumulative data which shows, varying with different investigators, that 20 to 30 per cent white and 30 to 60 per cent colored women are prone to the development of uterine myomas, the fastigium being reached between thirty and fifty years of age.

There is no questioning the fact that thousands of symptomless uterine fibromata go unrecognized and that many are discovered accidentally. While a few unauthenticated cases have been reported as occurring before puberty, it must be recognized purely and simply as a disease of the child-bearing period of a woman's life, receiving its stimulus for development as a result of congestion incident to menstruation, confirmed in the fact that with the establishment of the menopause, the tumors tend to atrophy and degeneration.

## ETIOLOGY

Many theories have been offered as to the probable origin of fibromyomas, the

most feasible of which is that expounded by Roesger, Gottschalk and others that they develop from the musculature of small arteries.<sup>3</sup> However, not any border on a hypothesis. The most interesting singular fact is that histologically the tumors consist of the same connective and non-striated muscle tissues as constitute the normal uterine substance and differ only in their structural arrangement.

## IRRADIATION

Soon following the discovery of radium by Madam Curie in 1898 and improved x-ray technic, there was a tremendous change in the treatment of uterine fibroids and it seemed for a time the surgical treatment would become extinct. However, today, in the vast majority of cases it must be acknowledged as the most important and trustworthy of all known methods. It is not the intention of the writer to belittle the value of radium and x-ray in the treatment of uterine myomas, although he is of the opinion they are overestimated by the enthusiasm of many roentgenologists and radium therapists. Obviously, W. J. Mayo clearly stated the sentiment of the surgical profession when he said "Radium must justly be considered in selected cases as a competitor of hysterectomy but it has no comparative standing in cases suited for myomectomy."

## CLASSIFICATION OF INDICATIONS FOR OPERATION

In the presence of uterine myoma there are certain definite indications under which surgical intervention should be instituted unless precluded by constitutional diseases or obesity, the presence of which would necessitate a hazardous risk. For the purpose of description they have been

\* Read before the Academy of Medicine, Columbus, Ohio, October 14, 1929.

classified with relation to their importance as follows:

1. Tumors with benign or malignant degenerative changes which Noble has classified as follows:<sup>4</sup>

CLASSIFICATION OF DEGENERATIVE CHANGES

Form of Change	No. Cases	Per Cent
Hyaline.....	72	3.1
Hyaline with calcareous infiltration.....	8	0.3
Calcareous.....	39	1.7
Myxomatous.....	89	3.4
Cystic.....	58	2.5
Hemorrhagic.....	13	0.57
Necrosis.....	119	4.7
Fatty degeneration.....	7	0.25
Edema.....	17	0.74
Sarcoma.....	34	1.4
Carcinoma corpores.....	42	1.8
Carcinoma cervix.....	16	0.7

He finally concluded that these degenerative changes occurred in 62 per cent of fibroma of the uterus. It is unnecessary to mention the importance of early recognition and radical operation in the presence of the last two mentioned conditions, namely sarcoma and carcinoma. Even as early as 1921, Essen Moeller<sup>5</sup> reported 22 malignancies in 700 fibroid cases, 6 of which were cancer and 16 sarcoma. That sarcomatous degeneration occurs relatively more frequently than is commonly believed by the general medical profession has been proved by Winters<sup>6</sup> most thorough and definite microscopical findings of 4 per cent. The frequency of carcinoma, which in itself is not a definite degenerative process as it must originate from epithelium, has been proved by Weibel<sup>7</sup> who reported a series of 1000 uterine myomas in which carcinoma of the fundus was found in 20 cases and Noble<sup>8</sup> who states that cancer was present in 2.8 per cent of a series of 4880 cases of fibroids collected by him. The cervix was involved in 1.29 per cent and the fundus in 1.05 per cent. Note the reversal of the location of the tumors to that found under ordinary conditions. In the writer's series of 68 uterine fibroids, 3 cases were complicated

by carcinoma of the fundus and 1 by carcinoma of the cervix.

2. Tumors accompanied by inflammation frequently subsequent to degenerative changes involving the tumor itself or infection or disease of the appendages. Cullens, Popow, Virchow, Tait, McDonald and Webster are of the opinion that 50 per cent of all uterine fibroids are accompanied by inflammation of the adnexa. However, as in the case of the hen and the egg, no one seems prone to state definitely whether the tumor resulted from the appendageal inflammation or the appendageal inflammation resulted from the presence and growth of the fibroid. Nevertheless, the presence of the inflammation in association with fibroids is a definite indication for surgical intervention and surgical intervention only, not radium or x-ray.

3. Tumors accompanied by pressure symptoms resulting from impingement on the bladder, ureters, and rectum characterized by irritability of the bladder with frequent, urgent, and painful urination and not infrequently urinary retention, which unrelieved, ultimately terminate in cystitis with bladder wall distention and thickening, hydroureter and hydro-nephrosis with final permanent destruction of the normal kidney substance. Pressure upon the rectum frequently results in constipation, autointoxication and anemia. The tumor or tumors are usually wedged and firmly fixed in the pelvis; however, small intraligamentous tumors are frequently of no little source of disturbance.

4. Tumors 15 cm. in diameter equal to four months' pregnancy or larger should be removed surgically especially in women under forty years of age as irradiation in sufficient amount to cause an appreciable shrinkage in the size of the tumor would result in irreparable damage to the ovaries. In fact, opinion is rapidly becoming established that the effect of irradiation on uterine fibroids is secondary to its effect on the ovaries. Masson states: "Apparently there is little or no decrease in the

size of a tumor after treatment by roentgen rays or radium unless the doses are powerful enough to precipitate the menopause."<sup>8</sup>

5. Tumors present in sterile women of suitable age with a desire to bear children when other conditions productive of sterility have been eliminated should be removed surgically. Mayo reports 23 pregnancies following myomectomy in 151 married women and Stacy, 28 pregnancies in 203 myomectomized women.

6. Tumors with relation to their position which may be classed as pedunculated and submucous in type, all doubtful cases and rapidly growing tumors, especially those accompanied by hemorrhage unrelieved by other known means.

#### TYPES OF OPERATIVE PROCEDURE

The surgical procedure necessarily resolves itself into two definite plans, myomectomy, conservative in type, and hysterectomy, radical in type, each of which has proved of equal safety relative to mortality. At the Mayo Clinic extending over a period of five years, 259 myomectomies had been performed with 2 deaths (0.77 per cent) and 1643 hysterectomies with 31 deaths (1.88 per cent).<sup>9</sup> In 1926 under the caption of "The Safety of Hysterectomy" the writer reported a personal series of 182 hysterectomies with a mortality of 1.07 per cent. Since that report, 74 additional hysterectomies have been performed, increasing the total to 256 with 9 deaths or a mortality rate of 3.51 per cent. An increase in mortality has been noted which is accounted for in the fact that with increasing experience, a feeling for more conservatism in pelvic surgery has developed which naturally relegates the less critical cases to myomectomy, leaving the more critical cases for hysterectomy. Statistics show death following either operation to have resulted from accidental factors in the majority of cases, pulmonary embolism contributing to over 50 per cent of the cases.

Myomectomy like hysterectomy has certain definite indications for its adoption.

However, each case predisposes certain personal status in regard to age, occupation, social and financial position and the desire to bear children. When these deductions have been made, myomectomy may be said to be the operation of choice in the majority of patients under thirty-eight years of age with single or several isolated tumors located in such a position in the uterus that they can be readily shelled out without unreasonable damage to the uterine substance. Especially does this apply to isolated sessile and pedunculated tumors as well as many of the interstitial varieties. The hope of pregnancy and desire to conserve the menstrual function call for conservatism. Bonney successfully removed from the uterus 30 fibroids in one patient by myomectomy. Kelly successfully removed 9 tumors through separate incisions on one patient and 12 tumors in another, and twice removed tumors as large as a man's head by myomectomy.

#### METHOD OF HYSTERECTOMY

Hysterectomy solicits three methods of procedure, namely, subtotal, total and vaginal, each of which should be determined by definite indications. The uterus should be removed in part in the presence of all fibroid tumors accompanied by hemorrhage or profuse discharge uncontrollable by other means. Total hysterectomy should be performed when definite evidence signifies involvement of the cervix. That total hysterectomy can be performed by competent surgeons as safely as subtotal has been proved by the data of many operators. In a personal series of 256 hysterectomies there were 159 total hysterectomies with 6 deaths (3.64 per cent), 96 subtotal hysterectomies with 3 deaths (3.12 per cent), and one vaginal without mortality.

Upon sufficient evidence of malignant degeneration but one procedure is left to choose from and that is panhysterectomy. At the Mayo Clinic over a period of five years 16 cases of carcinoma of the cervix were accumulated from three to

fifteen years following subtotal hysterectomy for non-malignant growths and 13 cases in which it was impossible to determine the existence of malignancy at the time supravaginal hysterectomy had been performed. Subtotal hysterectomy should be the choice, once the involvement of the cervix has been ruled out, in all cases of uterine myoma complicated by inflammation of the appendages, especially when as a result of severing adhesions the organ would be denuded to such an extent that further adhesions in the pelvis would be inevitable, and in all cases in which removal of the fibroid by myomectomy would necessitate an appreciable sacrifice of uterine substance.

#### SUMMARY

It is the writer's conclusions that the surgical treatment of fibroids has been too radical; that sound surgical judgment must

be exercised in determining the choice of operation lest one become ultra-conservative which leads to unsatisfactory results; that the value of irradiation has been overestimated and finally, it must be remembered that a patient with fibroids is being operated on and not alone a uterus with fibroids.

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# AN IMPROVED AIR INJECTION APPARATUS FOR THE INFLATION OF JOINTS\*

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RECENTLY there has been a great deal of work done on the inflation of joints, either of the chronic arthritic or acute purulent types. In the main, this has been carried out by means of the syringe method or by means of more or less cumbersome implements; therefore it was with this idea in mind that an improved method was sought. The first personal attempt was carried out on the Bone and Joint Service of the Boston City Hospital in 1928, and there the cases chosen for the inflation were mainly of the acute gonorrheal type. The results in these were quite encouraging, but it is not the author's idea in writing this paper to bring out the clinical data established in those cases. The purpose of this paper is to present to the profession a very compact and efficient apparatus for the inflation of joints by air.

The advantage of the improved apparatus is, of course, to allow for complete aseptic aspiration of the diseased joint, and secondly to have an absolutely aseptic method of inflating the joint with sterile air, at the desired pressure.

The complete set as shown in Figure 1 consists of a mercury manometer, a sterilizing chamber, a detachable rubber connection, one end of which attaches to the exhaust of the sterilizing chamber, the other end fitted with a two-way adaptor. The adaptor will accommodate the syringe and aspirating needle. Figure 2 shows the detachable portion of the set and is seen to consist of the rubber connection, adaptor, syringe, needle and release valve. This portion is boiled as often as it is used, and if necessary several of these parts can be kept on hand in sterile packets all ready for use.

The manometer, sterilizing chamber and

pressure bulb are mounted on a small detachable metal stand. All parts can easily be taken down and will fit into a very compact case.

*Principle of Operation.* The principle consists in delivering air to the sterilizing chamber which is constantly governed by the manometric pressure as indicated on the mercury column. The air is bubbled through the sterilizing solution which completely precludes the danger of carrying any particles of dust or contaminated material over into the joint. The exhaust tube of the sterilizing chamber therefore supplies the air in pure form to the sterile rubber tubing and attachment. The pressure is constantly governed and easily controlled by the bulb attached to the manometer. The sterilizing solution used is 70 per cent alcohol.

*Technic.* The joint to be inflated is scrubbed, shaved and painted with iodine or other suitable skin antiseptic. Sterile sheets are draped around the area to be used and the sterilized unit is then attached to the exhaust of the sterilizing chamber. The syringe and aspirating needle are attached to the threeway adaptor and with the skin previously anesthetized with the aid of novocaine or ethyl chloride, the needle is inserted into the joint cavity. The fluid, if there be any, is then aspirated by means of a 20 c.c. syringe and the specimen kept in a sterile tube for bacteriological examination. When all the fluid has been removed, the two-way cock is turned, thereby opening the channel between the sterilizing air chamber and the aspirating needle, and cutting off the path to the syringe. The air is then slowly forced into the joint by pressure on the bulb in much the same manner as in taking a blood pressure. The joint space is then seen

\* Submitted for publication February 17, 1930.



gradually expanding and depending upon the amount of pressure used, will be either soft or quite firm to palpation. Generally

that only the resistant, thickened or adherent synovial membrane will remain in contact with the adjacent tissues. When

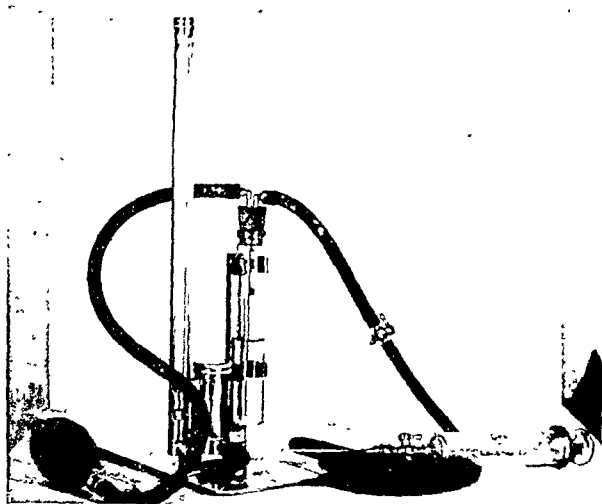


FIG. 1. Complete set assembled and ready for use. Sterilizing chamber and manometer attached to a demountable metal stand. All parts fit into a small compact case.

speaking, 40 to 50 mm. of mercury pressure will be easily tolerated by the average

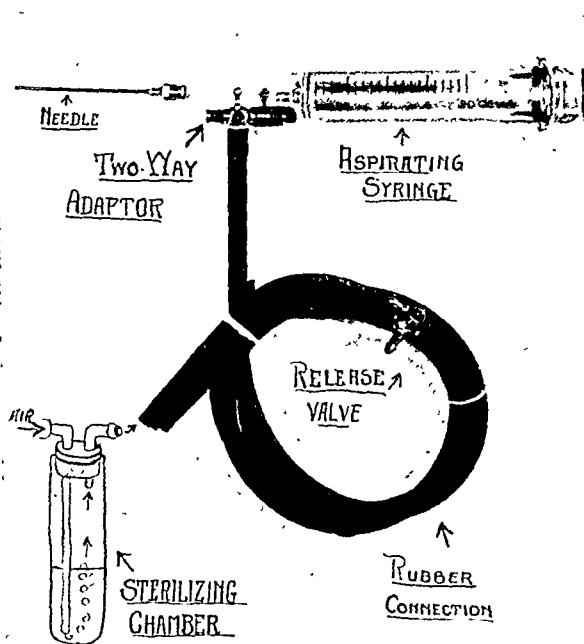


FIG. 2. Boilable parts of set. Release valve allows immediate release of injected air, if so desired.

patient without discomfort. It does not seem that greater pressures are necessary, as under these conditions it will be seen

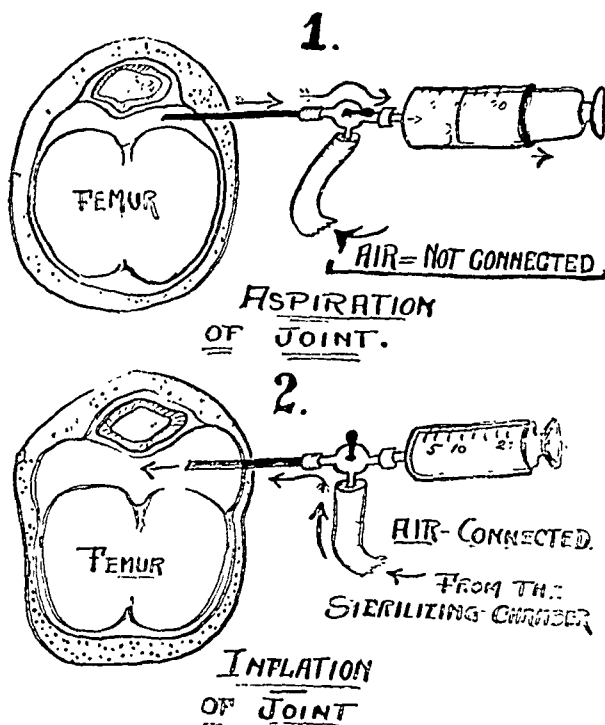


FIG. 3. Drawings showing needle in joint space. No. 1 shows aspiration to remove fluid, and ascertain that needle is not in blood sinus. No. 2 shows injection of sterile air, with synovial membrane distending.

the desired pressure has been attained, the needle is withdrawn and the punctured wound painted with collodion. An injection usually suffices to keep the surfaces apart for a period of from three to seven days after which time it can be repeated. If another joint is to be injected at the same time, the syringe and aspirating needle together with the rubber connection may be reboiled or another set kept on hand for immediate use. *It is very essential before injecting air that the needle is not in a blood vessel or sinus, as serious results may ensue if air under pressure is injected into open veins.*

**Summary.** The author has personally used this method on the following types of joint condition:

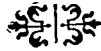
1. Chronic arthritis with effusion.
2. Acute gonorrheal arthritis.
3. Acute infectious arthritis.
4. Synovial tuberculosis.

5. Hemophiliac joint (1 case only).
6. Postoperative tuberculous synovitis with synovectomy (1 case only).
7. Suggested use on joints immobilized in plaster casts over long periods of time to try to prevent some of the troublesome joint stiffness seen in these cases, reference being made to cases with fractured femurs, etc., in plaster spicas.

The results of these cases seem very promising and interesting, and the data will form the basis of a later paper. It is felt that in presenting this simplified set, that a great many more of the profession

will realize the adaptability of an accurate and simple apparatus in the growing practice of producing pneumoarthrosis in certain pathological joint conditions. The author sincerely hopes that some of the men who are particularly interested in this line of work will offer any suggestion or criticisms they may deem advisable.

The author wishes to express his gratitude to Dr. E. A. Sommer of Portland, Oregon, and to Drs. W. B. Coley, Arthur Krida, Bradley Coley and J. McWhorter, for their kind suggestions and help in this work.



# CASE REPORTS

## CHRONIC PANOSTITIS\*

INVOLVING ATLAS AXIS AND THIRD CERVICAL VERTEBRA

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**I**NASMUCH as panostitis of the upper cervical vertebrae is uncommon this report of a fatal case should prove of interest.

A thirty-seven-year-old female, married, had been admitted to the hospital on four occasions within a period of about twenty months.

The only previous noteworthy illnesses had been chicken-pox in childhood and influenza in adult life.

March 26, 1928, first admission to hospital, diagnosis: Neurotic with mitral disease. Throat: "pillars injected, red, tonsils are red, congested, appear infected." Basal metabolism rate, +13. Urine, negative. Wassermann, reaction negative. White blood corpuscles 13, 150; polymorphonuclear 76 per cent, small mononuclears 13 per cent, large mononuclears 8 per cent. Sugar tolerance fasting 102; first hour 308, leucocytes second hour 250, third hour 220, suggesting hyperthyroidism. Gastrointestinal series, negative. Gall bladder normal.

August 14, 1928, second admission, diagnosis: Thyrotoxicosis (infective in origin). Pharynx appeared injected, also left anterior pillar. Throat shows small atrophic tonsils from which cheesy exudate is easily expressed. "If thyroid disturbance exists it is probably on an infective basis from tonsils and gums." B.M.R. +8.

September 8, 1928, consultation and examination by Ear Nose and Throat Department revealed left tonsil submerged, anterior pillars inflamed, considerable caseous material expressed from left tonsil. B.M.R. -6. Impression: "chronic infected tonsils."

October 4, 1928, Tonsillectomy under local anesthesia with much improvement in patient's condition. Weight on admission 91½ lb., on discharge 94 lb. Hemoglobin 75 per cent, R.B.C. 3,890,000. W.B.C. 7200, P.M.N.L. 68 per

cent, S.M. 30 per cent, L.M. 2 per cent. Throat culture, staph. and strep. Sugar tolerance fasting 120: I, 200, II, 205, III, 190.

May 13, 1929, seen in Out-Patient Department, Ear Nose and Throat Clinic, with an acute coryza; complaining of a burning sensation in posterior pharynx. There was some injection, with irritation of the mucous membrane. Lymphoid tissue in upper pole, left tonsillar fossa. Aseptic treatment directed to nose, none to throat.

July 18, 1929, throat painted with silver nitrate 2 per cent. Complained of being afraid to eat because of a choking sensation. Impression appears to be hyperthyroidism, though B.M.R. has always been within normal limits.

July 25, 1929, seen at home suffering with acute lateral pharyngitis which gradually localized with abscess formation over right posterior pillar. Incision with release of pus. Remained in bed at home for one week. Neck began to feel stiff, and throat not so sore.

August 8, 1929, seen in Out-Patient Department, Ear Nose and Throat Clinic, complaining of ears aching, difficulty in swallowing at times, neck feeling rigid. Appears to have lost great deal of weight. There is a discharging opening in right posterior pillar which is much swollen. Neck is held rigidly, some tenderness over muscular insertions. Temperature, 98°F. Pulse, 104. Throat culture: Strep. predominating; also Putrifecans. x-ray of cervical vertebrae with report of "No radiographic evidences of pathology."

August 11, 1929, third admission, diagnosis: Retropharyngeal focal infection giving rise to cervical myositis and fibrositis. Urine, negative. R.B.C. 3,710,000. W.B.C. 10,000; P.M.N.L. 75 per cent, S.M. 14 per cent, L.M. 9 per cent, T.R. 1 per cent, E. 1 per cent. Throat culture, Strep.

August 13, 1929, examination revealed an

\* Submitted for publication, February 26, 1930

opening surrounded by pale granulations on the right posterior pharyngeal wall in region of the posterior pillar, discharging thick greenish-yellow pus. The area was swollen, with some stiffness of the neck especially on backward movement; tenderness over back of neck, more marked on left side. Cervical glands not palpable. No tenderness over spine. Impression: "Post-pharyngeal space abscess; vertebral caries?"

August 15, 1929, under local anesthesia, the pharyngeal opening was widened and granulations curetted. Probe went back to spine, but no bare bone was felt.

August 22, 1929, injection around opening a little smoother, with paler cheesy pus still discharging from the sinus. Neck rigidity is perhaps a little less.

August 24, 1929, Esophagoscopy: nothing below cricoid; edema above cricoid with narrowing of esophagus.

September 7, 1929, discharged from hospital to return to Out-Patient Department for diathermy and observation.

September 14, 1929, seen in Out-Patient Department, improving, being treated by physiotherapy.

September 19, 1929, an x-ray with probe inserted in fistulous tract revealed "Rather marked destruction of the upper anterior portion of the body of the third cervical vertebra which was not present on previous examination, (August 8, 1929). The probe inserted through the fistulous tract seen to extend down to this necrotic portion."

September 21, 1929, transferred to Orthopedic Clinic. On examination patient appeared nervous, complained of having a choking sensation for past two years. Presence of a chronic discharging abscess and sinus in right retropharyngeal space would indicate that a long standing pathology exists in that region. The probability of bony involvement was immediately suspected. All efforts at movement of head, painful and very limited. Some muscular rigidity of the anterior muscle groups of the neck. Head held very guardedly. Loss of weight apparent for past two years. Immediate hospitalization recommended.

September 24, 1929, x-ray of cervical vertebrae revealed necrosis previously noted in the third cervical vertebra further advanced with some beginning necrosis in the lower portion of the second cervical vertebra.

When she was referred to the Orthopedic

Department the diagnosis of cervical tuberculosis was made clinically. It was felt that regardless of the type of bone disease the



FIG. 1. Looking down upon atlas, showing marked destruction of anterior arch and extensive erosion of right superior articular surface.

FIG. 2. Looking up upon base of axis, showing erosions.

FIG. 3. Anterior view, showing destruction of odontoid process and extensive destruction of atlas and axis.

FIG. 4. Posterior view, showing extensive erosion and ossification between laminae of atlas and axis.

treatment of primary importance would be recumbency with fixation and temporary moderate traction. Because of the many neurological symptoms manifested, e.g.: exophthalmus, nystagmus, light flashes, spots before the eyes, tremor, as well as choking sensation following swallowing of food, enlargement over thyroid and the general imbalance of the sensory nervous system, a consultation was requested with the Neurological Department. The diagnosis, with remarks follow: "T.B. of atlas (Runge? syndrome), T.B. of thyroid (?) or hyperthyroidism. These conditions are usually fatal. Outlook very grave. Only treatment is complete fixation of the head. Morphine sulphate to be used freely." Hg. 75 per cent, R.B.C. 3,950,000. W.B.C. 11,300: P.M.N.L. 78 per cent, S.M. 21 per cent, L.M. 1 per cent. Sputum and throat culture, negative for tubercle bacilli.

During the patient's recumbency the head fixation with traction was carried to the point of tolerance. There were times when it became

necessary to relieve weight suspension because of aggravation of pain which this treatment occasioned. However, after recumbency with

October 29, 1929 she was able to walk about with assistance and after a few days was walking unaided. Patient presented all evi-

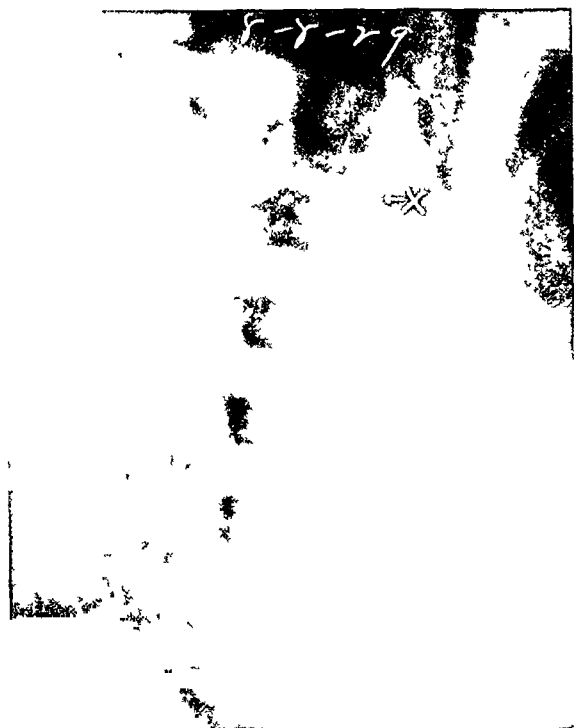


FIG. 5. Film taken August 8, 1929, showing no evidence of pathology.

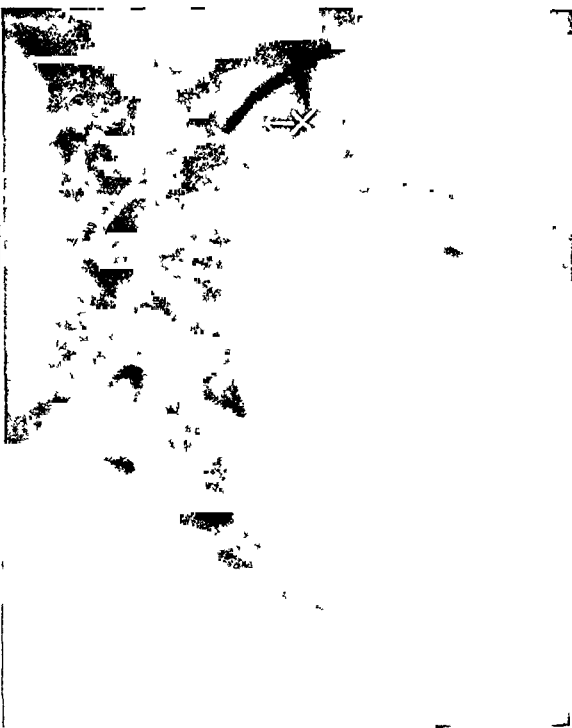


FIG. 6. Film taken September 19, 1929. Probe inserted through fistulous tract is seen to extend down to necrotic third cervical vertebra.

a varied fixed policy of head traction for about six weeks, during which time a normal temperature was established and the general condition of the patient improved, a semi-soft collar was decided upon. To apply this apparatus was a delicate procedure in this instance, because of the danger of disturbance to the suppurating process and a flare up of the bony pathology.

October 17, 1929 a snug and highly fitted collar of felt with plaster-of-Paris reinforcement was placed about the neck. Close upon the application of this collar, although the patient complained about its being tight and limiting the motions of the chin, she admitted she was more comfortable. The general symptoms complained of, pains about the head, vertigo, flashes, spots and blurring of vision, difficulty in swallowing, swelling and pain about the ears, etc., gradually diminished. The patient became more cheerful and began taking on weight. Two days after application of collar, she was able to sit up with support of a back-rest although vertigo, tinnitus and impaired vision were still fleeting disturbing factors.

October 25, 1929, began getting out of bed on wheelchair.

dences of feeling much more comfortable than on admission to the Service and plans for her going home soon were uppermost in her mind. During the course of this treatment patient was constantly swallowing the discharge from the fistulous retropharyngeal opening. She was instructed to expectorate this material whenever possible, and it was no difficulty at any time to obtain pus which was thick and very tenacious in character, sometimes yellowish green in color and often blood-streaked.

November 4, 1929, or thereabout, it was found that the collar support was becoming very loose, that the neck was much smaller, and that even the height of the collar was insufficient to hold the head in the original fixed position. Symptoms such as those complained about on admission began to reappear fleetingly and for increasingly longer periods. It could be seen that the collar was not holding the head sufficiently firm. Because of the increased mobility of the head the collar was elevated with a  $\frac{1}{2}$  in. thickness of piano felt which was placed between the lower portion of the collar and the base of the neck as a tem-

porary expedient, until a new collar could be applied. A gradual improvement in her general condition with temperature decreasing and pain diminishing was apparent.

November 12, 1929, or thereabout, a setback from her previously encouraging convalescence set in most rapidly. There was a sudden marked rise in temperature with correspondingly increased pulse and respiration rates. The face became flushed, patient complained of severe headache, pains in ears, dizziness and marked disturbances of vision.

November 14, 1929 in the evening patient developed an alarming condition. It was reported she had raised herself in bed and that the head fell back, as though snapped, when she was in the erect position. In all likelihood the odontoid process of the axis broke away at this time. (At post mortem the axis was found with this process unattached.) When seen by me on this evening the patient was in a comatose state, head firmly fixed, face flushed, pupils dilated and eyes staring vacantly. Her speech was of a mumbling muttering type except when aroused. She was able to give yes or no answers to questions and her sight was not entirely gone. The head was drawn backward, the knees and hips flexed. She gave the appearance of having some central nervous disturbance of serious character.

November 15, 1929 when seen in the morning her condition was grave. She appeared moribund. She had a vacant stare, eyes widely open, pupils dilated with no reflex response to light or accommodation. There was no response to questioning, she mumbled incoherently, upper and lower extremities were flexed, face flushed and expressionless. It was clear there was a marked central disturbance with involvement of the meninges.

November 16, 1929, patient expired.

An autopsy was performed by Dr. K. Yardumian, pathologist of Montefiore Hospital, and his report follows:

The body is that of a white female, about the age of forty, fairly well nourished and well developed. Rigor mortis well set; moderate lividity present at the dependent parts of the body. On general inspection, the neck was found to be surrounded by plaster-of-Paris cast. The head was covered by dark brown hair with a few gray ones in between. There was a decubitus at the posterior part of the occipital region, the size of a silver quarter. The pupils

were evenly dilated. The cornea was slightly opaque. The ears and nose were grossly negative. The muscles of the neck were atrophic.

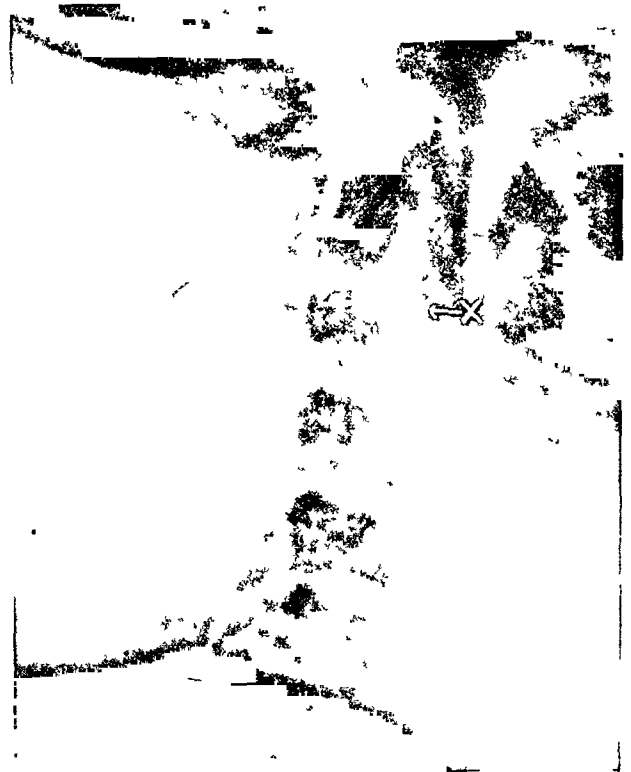


FIG. 7. Film taken September 25, 1929. Necrosis previously noted in third cervical vertebra is still present and beginning necrosis is now seen in lower portion of body of second cervical, and some rarefaction of body of first cervical vertebra.

Permission for autopsy was authorized to the head and limited portion of the neck.

The usual incision, from ear to ear, was made on the scalp. The cranium was sawed and the brain exposed. The meningeal vessels were dilated. There was a moderate increase of cerebrospinal fluid in the subarachnoid space. The fluid looked rather clear and transparent. On further sectioning, at the posterior fossa of the base of the cranium and below the falx cerebellum, there was a great amount of turbid fluid. The inferior surface of the cerebellum and the pons at the medulla were covered by thick yellowish fibrinous exudate. Smears and cultures were taken from these respective places. The brain was removed as a whole and amputated below the medulla. The anterior margin of the foramen magnum looked eroded and rough and was covered with similar exudate. Posterior incision was made at the angles of the occiput and the neck, and the

first two vertebrae were removed (that is atlas and axis). The two bones were firmly united to each other. No motion could be



FIG. 8. Post-mortem x-ray. Further advance of necrosis of third and second cervical vertebrae, and also necrosis of first cervical.

elicited. The body of the atlas looked rough and rarefied. One condyle looked fairly normal; the other one was slightly eroded. The odontoid process of the axis was completely necrosed. The articular surface was destroyed and was very rough; portions were easily pulled away and ragged. It was rarefied and disintegrated. No evidence of thickening or healing process found. No caseation present. The body of the atlas showed similar destructive changes. The periosteum was denuded. The third cervical was palpated at its position, but not removed. The body of it was rough, necrotic and rarefied. Numerous smears and cultures were taken from those necrotic areas.

Through the same incision, an attempt was made to remove pieces of thyroid gland. Extreme care was taken not to disfigure the body; therefore the incision was closed without further exploration.

Finger introduced through the mouth to nasopharynx at the superior posterior angle near to the center showed a sinus leading to the vertebrae of the neck. A large amount of purulent exudate ran out freely.

*Microscopical Studies:* Numerous smears

were stained for acid-fast organisms and proved negative. Cultures from meningeal exudates from various necrosed bones proved a growth of organisms of which staphylococcus pyogenus aureus predominated. Other organisms were common flora of nasopharynx, such as diphtheroidal bacilli, few streptococci, pneumococci, etc.

Pieces of bones were removed from the odontoid process of the axis and the body of the atlas was decalcified in 10 per cent nitric acid solution, sectioned and stained.

The microscopical picture of the bone is as follows:

Marked rarefaction and decalcification of the body; intense leucotic infiltration both polymononuclear and mononuclear type.

No attempt of regeneration and new bone formation is present.

No evidence of caseation of tubercular reaction seen. Also acid-fast stains disproved presence of any such organisms.

*Diagnosis:* Chronic panostitis involving bodies of the first, second, and third cervical vertebrae.

Terminal purulent meningitis involving the base of the cerebellum pons and medulla (staphylococcus pyogenus aureus predominating and few of the designated flora of the nasopharynx).

*X-ray examinations and reports* by Dr. Maurice F. Goldsmith, roentgenologist, Montefiore Hospital.

It is interesting to see how really far necrosis of the cervical vertebrae advanced in this case. An heroic effort had been made by Nature to overcome this condition and the inability to fully fix this effort at ankylosis resulted in a meningeal involvement. The first, second and third vertebrae were all involved in this extensive process of bony necrosis and the brain involvement certainly exceeded expectations.

An otitis of any of the cervical vertebrae, more especially the upper cervicals, presents commonly a discouraging picture. This is further manifested after it has progressed into the chronic stage. An acute involvement of this type frequently responds favorably to treatment by free opening for drainage of the abscess, permitting same to repair from within outward. Fixation in such cases is mandatory, and is best obtained by head traction and weights at the outset to overcome spasm of the cervical musculature. These

muscles are in rigidity and spasm because of the effort of Nature to immobilize the vertebral bones involved. So long as drainage takes place from a sinus, whether retropharyngeal or postcervical, there remains nothing more to do beyond immobilization of bones of the diseased area. Further surgical interference is ill-advised. When the muscle spasm of the groups holding the head in rigidity has been overcome a proper fixation collar which rests directly upon the mid-clavicular region and base of neck is adequate support for the head. With such a collar the patient may be considered an ambulatory case. However, it should be realized that the swelling occasioned from the infiltration of such an inflammatory process and the infective materials in the soft structures about the involved vertebrae may cause considerable thickening of the neck. In such circumstances, what may appear as a tight-fitting collar at the outset will become very loose in the course of drainage of pus through an established sinus. The inflamed and infiltrated soft structures endeavor to assume their normal state. Therefore, the collar must again be adjusted for closer fitting from time to time to the neck of lessened thickness. Thus, there is further endeavor to prevent undue mobilization, with its consequent destruction from irritation, which would occasion a flare-up of the whole process with dire consequences.

In conclusion it is interesting to note that in cases of extensive necrotic cervical panostitis little remains to be done beyond fixation of the head and neck and expectancy from drainage obtained through any location whether retropharyngeal or postcervical. Ideally surface drainage is preferred to that of the oral route. Nothing

can be expected from drainage alone. From fixation much may be hoped for even though drainage is not yet established. Then, too, there is always the question of doubt as to type of infection in the cervical region. It may be tubercular and operation for evacuation of pus would be contraindicated. Whereas, when abscess formation has established itself, it can be readily determined whether same is non-tubercular. Opening for drainage when imperative might take place in the retropharyngeal region, but most certainly should not be the point of election for same if the postcervical region is available.

The diagnosis of tuberculosis of the cervical vertebrae is not amiss in a case of this sort. One would almost invariably consider this form of infection first. However, in any type of panostitis, the treatment would always be the same, namely: fixation and drainage. We were not convinced up to the last point of demonstration at autopsy as to the type of organism underlying the initial phase of the case. When finally the *Bacillus tuberculosis* was eliminated and it was established that the infection was from without (oral cavity), in all probability of recent date, the case was considered of sufficient interest for presentation. The predominating organism in the lesion was, as noted in the pathological report, *Staphylococcus pyogenes aureus*.

An expression of gratitude is extended Drs. M. F. Goldsmith and K. Yardumian for their helpful cooperation in preparing this presentation.





# ACUTE PANCREATITIS

WITH A REPORT OF TWELVE CASES\*

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UNDER this heading are included (1) acute hemorrhagic, (2) acute gangrenous and (3) acute suppurative pancreatitis. It is generally considered that these are merely various phases of the same disease and may follow one another or may occur concurrently in different parts of the pancreas in the same individual.

Acute pancreatitis is one of the tragic diseases of surgery. With sudden onset and rapid development it progresses all too frequently to a fatal outcome. Its etiology is obscure, its diagnosis difficult and its treatment unsatisfactory.

There has been much work done and many articles written on the various theories as to how infection reaches the pancreas. Deaver, Sweet, Judd and Mann have been the principal proponents of the lymphatic theory of infection, while Archibald and Kaufmann have carried out many experiments which would seem to show that infection takes place through the ducts. Superficially it would appear as if these two theories were diametrically opposed to each other and in fact their advocates seem, to some extent, to take such a view. Careful study of their various reports, however, does not necessarily lead to that conclusion. The adherents of the lymphatic theory are talking in the main about chronic pancreatitis which seems to be an entirely different condition and much more common than acute pancreatitis. That they are entirely different is pointed out by Sweet<sup>1</sup> who says "Chronic Pancreatitis equals infection, Acute Pancreatitis equals liberation of trypsin, by infection or trauma." Deaver<sup>2</sup> says "Extension of inflammation of the gall bladder mainly by way of the lymphatics gives rise to lymphadenitis

along the course of the common duct and its lymphatics in the right free border of the gastrohepatic omentum, and to a peripancreatic lymphagitis and lymph adenitis with enlargement and hardening of the adjacent portion of the pancreas itself." He cites several cases where this occurred not only from an inflamed gall bladder but also following an acute inflammation of the appendix. But he makes no claim to having seen anything more acute than a lymphangitis of the pancreas following such conditions. In the same article Sweet,<sup>2</sup> after discussing from an embryological standpoint the various relations possible between the emptying of the common and pancreatic ducts says:

Infection of regional lymph nodes might well cause a simple damming back of lymph with aseptic swelling of the interstitial tissue, later organization and increased interstitial tissue, which is precisely the picture of *chronic* pancreatitis. And Cases of chronic pancreatitis do not show clinical symptoms which might be ascribed to transitory attacks of limited acute pancreatitis with later transformation of the degenerated acini into sclerosed areas.

Mann's experiments as reported by Judd<sup>3</sup> consisted of injecting bile into the pancreas with a syringe at a pressure of 500 mm. or less, he having previously ascertained that the normal pressure of the liver and the contraction of the gall bladder combined did not exceed 350 mm.; and was not able to produce an acute pancreatitis. Archibald<sup>4</sup> doing the same experiment but using infected bile produced a typical necrosis of the pancreas. In summing up Judd<sup>3</sup> says:

If Mann's conclusions regarding the bile factor in the etiology of pancreatitis are cor-

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rect, it would seem that, in most cases at least, we must search elsewhere for the cause. It will most likely be found, as Deaver says, in the extension of infection to the pancreas through the lymph channels. It is possible that infection in cases of cholecystitis changes the bile so that it readily causes trouble in the pancreas.

Nordmann<sup>5</sup> found that normal bile entered the pancreatic duct without doing any particular harm while infected bile caused acute pancreatitis. Mann and Giordano<sup>6</sup> and Judd<sup>3</sup> have shown that in only 3.5 to 4.5 per cent of bodies examined, obstruction at the ampulla of Vater either by a stone obstructing the ampulla or by spasm of the muscle of Oddi, would convert the common bile duct and the duct of Wirsung into one continuous passage and so permit passage of bile into the pancreas. If one accepts the theory of infection through the ducts this fact which has been used as an argument against the theory might tend to explain the relative rarity of acute pancreatitis. Kaufmann's<sup>7</sup> experiments consisted of infecting the lymphatics around the gall bladder, around the ducts and around the pancreas itself. He succeeded in causing a lymphangitis and a lymphadenitis and by contiguity to infected nodes small infected areas in the pancreas but did not produce an acute pancreatitis. He, therefore, because of these results and because he cannot believe that lymph would actually flow backward into the pancreas, concludes that "the clinical proof which has always been based on the assumption that experimentally and anatomically, the lymphatic route of infection was possible, must of necessity be regarded as non-existing." But here again we can find no incompatibility with Sweet's theory as outlined above. A localized area of pancreatic necrosis may be caused by contiguity from infected nodes, or by contact with a duodenal or gastric ulcer. A possible etiology by a hematogenous route has been suggested by some authors. Hunt<sup>8</sup> asks why since the parotids are known to be

subject to specific infection, the same could not be true of the pancreas.

Acute pancreatitis occurs as a rule in middle-aged individuals, especially in those who are overweight. It is slightly more common in men than in women. Alcoholism and diseases of the biliary system are considered contributory causes.

Correct diagnosis is only occasionally made before operation. This is undoubtedly due to the fact that the disease is comparatively so rare in occurrence. The attack is ushered in by a sudden terrific pain in the epigastrium. According to Moynihan,<sup>9</sup> "of all the pains the human body can suffer, this is by far the worst." It may radiate to the back or either shoulder, especially the left. As a rule it is attended by marked collapse with rapid thready pulse, shallow breathing with characteristic dyspnea and fall in temperature. The temperature will rise on the second or third day. Vomiting generally occurs and is interspersed with retching and hiccough. Jaundice may or may not occur.

Examination of the abdomen shows moderate distention with tenderness and rigidity especially of the epigastrium. Tenderness in the gall bladder region extending beyond the midline is very suggestive. There occasionally is bulging of the flanks and the presence of fluid may be detected. Rarely it is possible to feel a mass in the region of the pancreas. A diagnosis of high intestinal obstruction or perforated ulcer is most apt to be made. In intestinal obstruction the pain is not apt to be as severe nor is collapse as marked. The vomiting occurs with little or no nausea, may be projectile in character and if long continued may become fecal in type. In perforated ulcer, a history of previous ulcer symptoms, obtained in about 50 per cent of cases, is of value. Tenderness and the rigidity which is generally more severe extend over the whole abdomen and are not more marked in the epigastrium than elsewhere. The presence of air under the diaphragm as

shown by x-ray would clinch the diagnosis of a perforated viscus. Lowe's mydriatic test has been of value in some cases. This consists of putting four drops of 1/1000 adrenalin in one eye, repeat in five minutes and examine at the end of thirty minutes. Dilatation of the pupil is a positive test. Glycosuria is not an infrequent finding and if it can be determined to be of recent origin, may be helpful in making the diagnosis.

Treatment consists of early operation. When the abdomen is opened, the presence of blood-stained fluid and areas of fat necrosis makes the diagnosis. However, these latter may be absent or may be confined to the root of the mesentery in the immediate neighborhood where they should be carefully looked for. In the more advanced cases the pancreas is felt to be enlarged with a tense capsule and depending upon the stage of the disease, there may be areas of softening or fluctuation. Operative procedures vary, depending upon the pathology present and the condition of the patient. In the very early cases where there is no pus or fluid present cholecystectomy seems to be sufficient. The general practice at present is to drain the biliary system either by means of a cholecystostomy or if the patient will stand a cholecystectomy by a tube in the common duct. All the fluid in the peritoneal cavity should be removed by suction and a drain placed to the capsule of the pancreas. If there is definite softening of the pancreas or abscess formation, the capsule should be split and a drain placed into the pancreas itself. In the very severe cases this is all that should be done as in these cases drainage is the essential need. Any free necrotic material should be removed, though none should be forcibly torn away due to the great danger of hemorrhage. The drain in the gall bladder or duct should be left in situ for two weeks or longer, but the drain to or into the pancreas can be loosened at the end of three or four days and removed as soon as the discharge diminishes.

Bailey<sup>10</sup> suggests the use of an ointment containing 2 per cent of hydrochloric acid to prevent the digestion of skin around the wound by the pancreatic ferment. Errors in carbohydrate metabolism should be carefully watched for and suitably treated. As hepatic insufficiency and a depletion of glycogen reserve are likely to be present, glucose infusions should be given both before and after the operation. Recurrence of the disease may take place after an apparent cure as is illustrated by one of our cases (No. 6).

Following is a summary of twelve cases operated on the First (Cornell) Surgical Division of the New York Hospital since 1914.

1. Male, aged thirty-nine. Dull pain in epigastrium for one week, vomiting for three days. No bowel movement for three days. Moderately alcoholic. Large man, cyanotic, diffuse rigidity and tenderness of abdomen most marked in epigastrium. Temperature 101.6°F; urine, no sugar. Operation, sweet-smelling turbid oily fluid in peritoneum. No fat necrosis. Pancreas enlarged and indurated. Cigarette drain to pancreas. Died sixteen hours postoperative. Autopsy showed multiple abscesses.

2. Male, aged thirty-two. Sharp cramp-like pains in lower abdomen for four days. Nausea but no vomiting. No bowel movement in three days. Obese man, distended abdomen, rigid in right upper quadrant, tender to left of umbilicus. Temperature 102°F. Operation turbid serum especially in lesser sac. Multiple hemorrhagic areas. Pancreas swollen. No definite fat necrosis. Lesser sac and gall bladder drained. Died five hours postoperative.

3. Male, aged forty-five. Pain in abdomen for one month, severe for eighteen hours. Vomited once, moderate belching. Marked rigidity and tenderness on right side. Temperature 100°F. White blood count 1800, 87 per cent. Operation, small amount of bloody fluid, fat necrosis. Pancreas necrotic, hemorrhagic and soft. Drain to pancreas. Left hospital cured on eleventh postoperative day.

4. Male, aged fifty-seven. Pain in epigastrium with vomiting for two days. Indigestion for one year. Obese man, distended abdomen, fluid wave present, tenderness in epigastrium,

markedly cyanotic. Operation, large amount bloody fluid, fat necrosis, pancreas large, swollen, indurated. Temperature 101°F. Died on operating table. Was operated at family's insistence though moribund on admission.

5. Male, aged forty-three. Pain in epigastrium for six days. Well nourished. Abdomen hard and boardlike, tender all over. Temperature 97°F. White blood count 7600, 72 per cent. Operation, oedematous gelatinous infiltration of peritoneum. Pancreas swollen and soft. No fat necrosis. Cholecystostomy. One stone present. Home on thirty-third day.

6. Male, aged forty-one. Epigastric pain for two days. Vomited several times. No bowel movements for two days. Two previous attacks. Moderate distention, tenderness all over, especially right upper quadrant. Temperature 101.6°F. Blood count 14000, 78 per cent. Operation, small amount straw colored fluid. Spots of fat necrosis. Large hemorrhagic mass head of pancreas. Gall bladder normal. Cholecystostomy and drain into mass of pancreas. Discharged on seventeenth postoperative day. Readmitted thirty-seven days after discharge. Had been well for four weeks. Similar symptoms and signs. Operation showed pancreas two and a half times normal size. No fat necrosis. Gall bladder and pancreas again drained. Died first postoperative day.

7. Female, aged fifty-three. Severe pain right upper quadrant for two months; had had it at intervals for eleven years. Obese, tender across center of epigastrium. Temperature 103.6°F. Blood count 17,200, 84 per cent. Operation, moderately distended gall bladder containing stones. Pancreas enlarged throughout. Fat necrosis present. Mass in upper surface of pancreas contained 1 oz. of thick pus. Some bleeding. Pancreas packed. Gall bladder drained. Died third postoperative day.

8. Female, aged twenty-eight. Sharp pain left upper quadrant for eight days. Nausea and vomiting for two days. Mass right side, tenderness, no rigidity. Temperature 100–102°F. Blood count 15,000, 92 per cent. Operation, whole pancreas acutely inflamed, fat necrosis. Gall bladder small, infiltrated. No stones. Gall bladder drained. No drainage of pancreas. Ten weeks later a pancreatic abscess was drained. Died sixteen hours postoperative.

9. Female, aged thirty-seven. Epigastric pain for three days. Vomited. Similar attacks

for six years. Obese, tenderness and rigidity in right upper quadrant. Temperature 100–102°F. Blood count 10,500, 78 per cent. Operation, cholecystostomy. Fat necrosis throughout. Hemorrhagic areas in body and tail of pancreas. Reoperated for secondary hemorrhage two days later. Died.

10. Female, aged twenty-six. Operated eighteen months before for acute cholelithiasis. Pain in right upper quadrant and epigastrium for three days. Vomiting. Tenderness and rigidity in right upper quadrant. Temperature 101–102°F. Blood count 17,800, 92 per cent. Operated, stone removed from common duct, pancreas swollen. No fat necrosis. Duct drained. Discharged cured four weeks later.

11. Female, aged sixty. Pain in right upper quadrant, back and right shoulder for four days. Vomited. Similar attack five years before. Distended abdomen, contained fluid. Rigid in upper part. Tender. Temperature 101°F. Blood count 10,400, 84 per cent. Operation, pancreas enormously enlarged, fat necrosis. Gall bladder contained stones. Gall bladder and pancreas drained. Died thirtieth postoperative day. Autopsy showed pancreas to be largely destroyed.

12. Male, aged forty-four. Abdominal cramps, nausea and vomiting for twenty-four hours. Abdomen full and distended, rigid and tender on right side. Temperature 101–102°F. Blood count 15,150, 87 per cent. Operation, pancreas swollen and indurated. Fat necrosis and blood-stained fluid present. Drain placed to pancreas. Discharged cured on seventy-fifth day.

Of 12 cases 7 were males and 5 females. There were 8 deaths, a mortality of 66.66 per cent.

It would seem from these cases that earlier diagnosis and treatment of gall bladder disease might prevent the development of pancreatitis in certain cases.

I desire to express my appreciation to Dr. Charles L. Gibson for permission to publish these cases all of which were operated in his services at The New York Hospital.

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## SOLITARY CYST OF THE KIDNEY WITH RESECTION\*

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LARGE, single or solitary cysts of the kidney are of sufficient frequency to find reports on one or several cases in medical literature every year. The usual recommendation of treatment in the textbooks and the literature has been: resection of the cyst. However, nephrectomy has been the procedure in the larger proportion of cases reported in spite of recommendation. I have seen 14 of these cases, 7 in the past year, 4 of which were personally operated upon by me. Of all these cases only 1 on the operating table apparently had the possibility of a successful removal. In some instances the cases had cysts so large that the kidney itself was merely a thinned-out capsule of renal tissue, so to speak, attached to the outer surface of a large cyst. In other cases the cyst occupied the center of the kidney, with an upper pole and lower pole of renal tissue so widely separated, and the cyst itself so closely attached to the pelvis in the center, that a resection of the cyst, and a reunion of the two widely separated portions of the kidney seemed very difficult, if not impossible of accomplishment without leaving a permanent renal sinus and the possibility of an ultimate nephrectomy. In these 14 cases all were nephrectomized except one.

The resected case is as follows:

G. O. P., a physician, fifty-four years old, seen on July 22, 1929, complaining of pain

in the right side of the abdomen, radiating to his right testis. He had had a similar pain three years previously occurring on his left side, followed by hematuria. At that time the pain was attributed to a renal or ureteral calculus, but none was passed and none found on x-ray. X-ray at that time showed very large irregularly shaped kidneys, and a tentative diagnosis of polycystic kidneys was made. As a result he lessened his activities and gained 30 lb. in weight. After a year he became afflicted with dizziness and hypertension. A return to active work and reduction in weight brought his blood pressure down and relieved his dizziness.

When seen the patient was a stout, sturdy man, normal except for some tenderness in his right flank and a large mass, apparently the right kidney. The urine was normal.

Cystoscopic examination on July 24 revealed a normal bladder and urethra. Both ureters were easily catheterized to the kidneys. Clear urine was obtained from both sides, the flow from the left being twice that from the right in the same time. Indigo carmine appeared from the left kidney in three minutes and from the right in three and one-half minutes. In ten minutes the concentration from the left kidney was twice that from the right.

Bilateral pyelograms were done and showed a right kidney high up, with a slightly deformed pelvis and a round smooth mass below, evidently the lower pole of the kidney. The left kidney showed a large upper pole with an irregular cavity in the pole communicating with the pelvis.

Diagnosis was made of a large solitary cyst of the lower pole of the right kidney and a

\* Read before the Section of Genito-Urinary Surgery, N. Y. Academy of Medicine, December 18, 1929.

smaller cyst of the upper pole of the left kidney ruptured into the pelvis.

Operation was performed on July 25 and a large solitary cyst of the right kidney was removed by resection of the lower half of the kidney. The bleeding was profuse but was controlled by cross mattress sutures. The cut end of the kidney was covered by a thick flat pad of the lower part of the fatty capsule. A cigarette drain was placed outside of the fat and the wound closed. The patient had an uninterrupted recovery, the wound discharging a moderate amount of serosanguineous fluid. He was discharged on the fourteenth day.

The patient was apparently normal until the seventeenth day when following exercise and straining he had pain in his right side. This was followed by a chill and high fever, with passing of cloudy, burning urine.

Patient was readmitted to hospital on August 15 and the wound opened and several ounces of pus evacuated. The wound then drained freely of urine, followed by a recession of temperature. He passed urine containing pus and liquid fat. The fat would collect and harden on top of his urine. Wound was revised on September 1 and again on September 19 when his kidney was examined. At that time the fat pad over the lower renal pole had practically disappeared. The wound then rapidly closed up. With the administration of methylene blue by mouth, the wound coloration ceased in ten days following the last revision.

Cystoscopic examination on October 1 showed that his right kidney secreted a few pus cells, 0.8 gm. of urea per liter and had an indigo carmine appearance time of three minutes and equal with the left output in ten minutes. His left kidney was free from pus and secreted 0.6 gm. urea per liter. Pyelograms were not done at this time because of the risk of reopening the healed renal sinus.

In history this case was seen to fit the average. The cysts usually are silent and only discovered by accident although at times they may give rise to pain. The discovery of these cysts were by examination and x-ray. The pyelograms were characteristic. In studying these cases we have brought out that there is a peculiar clubbing and shape to the calyces; that the cyst is usually round and that the outline is clear, sharp, distinct and at

times almost capsular in density of outline; that the outline of the kidney tissue is distinct from the cyst, of a different



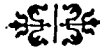
FIG. 1.

density, and at times can be definitely made out through the cyst. These findings are not those found in tumor.

This case was unusual in that it was the first in a fair number that had the aspect of having a fair chance in resection. Moreover there was a cyst on his other kidney which introduced the additional factor of conservation of the right kidney. In resection the kidney tissue was not cut straight but was beveled into the kidney in the shape of the cyst. This undoubtedly left cut renal tubules that did not communicate with the pelvis after the resection. They must have secreted urine under the fat flap and gradually necrosed it, and have broken down into the pelvis, forming an abscess at the lower pole. The cyst on the left kidney was silent and the kidney apparently normal, which has given rise

to the idea that when next we encounter a non-removable solitary cyst, we open the cyst into the pelvis or calyx through pyelotomy incision and then plicate the cyst. We have tried stripping these cysts out of the kidney in the laboratory, as we

strip an ovarian or any other cyst, but have found it exceedingly difficult to do so without tearing the cyst to pieces. In the resection we agree that it is best to cut straight through renal tissue well away from the cyst.



## MECHANICAL APPENDICITIS\*

PAUL W. GREELEY, M.D.

WINNETKA, ILLINOIS

**N**UMEROUS foreign materials are frequently reported as causing appendicitis. Most often the oxyuris

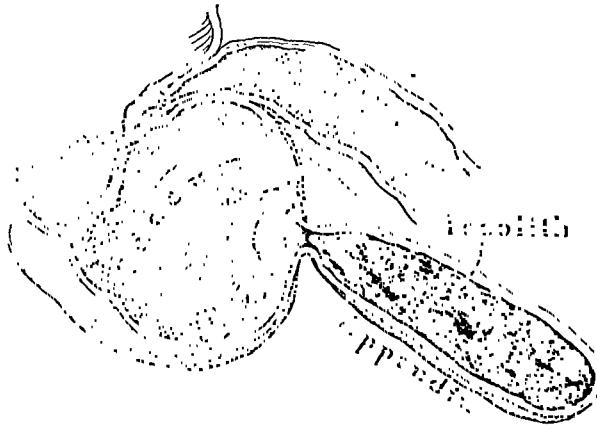


FIG. 1.

vermiformis, other intestinal parasites, cornflower and grape seeds, cholesterol calculi, shot, pins, etc., are the etiological factors. Fecal concretions are very common but recently I have encountered one of unusual dimensions causing an unusual type of pathology.

Mrs. N. D. gave a history of several attacks of pain in the right lower quadrant over a period of two years. The present attack had been in progress about twenty-four hours when

I first saw her. She described the pain as coming in waves, or intermittent in character with no definite time relation between the crest of each sensation. At the height, the pain would make her nauseated, but she did not vomit. Examination revealed a definite tenderness and rigidity of the muscles of the right lower quadrant. Vaginal examination showed nothing more. The pulse and temperature were normal and the white blood cell count 10,500.

A diagnosis of recurrent appendicitis was made and owing to the patient's discomfort, an immediate operation was advised. A right paramedian incision was made. A very large, gray-walled appendix was found. It was the size of a man's thumb and abruptly tapered at the base. It was removed by the usual ligation and purse-string inversion method. The patient made an uneventful recovery and has had no recurrence of the pain since her operation.

The pathological examination revealed that the lumen of the appendix contained one enormous fecalith, measuring 7.4 cm. long, by 2.0 cm. in diameter. The wall of the appendix showed very little change, except for some edema.

Of special interest was the size of the fecalith with such a small degree of associated inflammatory reaction, and also the apparent movements of the fecalith which undoubtedly caused the patient's pain, since it was too large to force its way into the cecum.

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## EDITORIALS

### POSTOPERATIVE PULMONARY EMBOLISM AND THE REVIVAL OF ARTERIAL EMBOLECTOMY AND THE TRENDLENBURG OPERATION IN SCANDINAVIA AND GERMANY

THE presence in this country of Drs. Gunnar Nystrom, of Upsala and K. H. Giertz, of Stockholm, and the contribution of their personal experiences to the proceedings of The American Surgical Association at its recent meeting in Philadelphia bring to mind the debt of the profession to the Scandinavian surgeons for their initiative and success in the surgical treatment of postoperative pulmonary embolism and the thrombo-embolic obstructions of the peripheral arteries. In fact, the operation of embolectomy for the extraction of obstructing clots from the blood vessels has become a specialty which is a distinctive and almost

unique feature of Scandinavian surgery. The numerous scientific contributions of the Swedish surgeons and their unusual experience in the surgical treatment of these thrombo-embolic complications have served to rehabilitate and revive the practice of embolectomy, which up to fifteen years ago gave little promise of the limb and life-saving value which they have since given it.

To those who are at all acquainted with the history of Scandinavian surgery, including Sweden, Denmark, Norway and Finland in this designation, the great impetus given by the surgeons of these northern countries to vascular surgery, particularly in its thrombo-



embolic relations, their activities and their recent achievements are not surprising. It would seem that this is something of a tradition with them which has been handed from the older to the younger generation as a national characteristic, to be cultivated and perpetuated as a splendid inheritance.

It would be impossible to do justice to the long list of Scandinavian surgeons who since the days of the great Danish pathologist Panum, of Copenhagen, have enriched the literature on thrombosis and embolism in all its complex phases by their notable and, in many instances, epochal contributions. Let us not forget that it was Panum who, next to Virchow, in the fifth decade of the last century, developed and expanded the concept of embolism in a series of experimental researches that have remained fundamental and classical to this day.

In later years, Sweden has taken the lead in this specialty. For instance, the collective statistical studies on postoperative pulmonary embolism contributed by G. Petrén of Lund in 1913 constitute an outstanding landmark in the history of this subject. In this masterly essay Petrén surveyed and summarized all the experience that had accumulated on pulmonary embolism as a surgical complication up to the time of its publication. In this he laid the foundation for the differential index of incidence of this formidable complication as it appears after operations on different organs and regions, at different ages and in various diseases, and it is Petrén's work which has served as a statistical model ever since. Of course, the names of Lennander, the great master of Upsala, of Borelius, of Axel Key and Retzius of Bull, of Nicolaysen, of Hansen, of Bauer, of Key and of Fähræus and Jacobæus (in cognate lines) and of so many other medical representatives of the great Scandinavian family are familiar to the readers of the *Acta Chirurgica Scandinavica* as eminent contributors to the knowledge and literature of this special field.

It was reserved, however, for the surgeons of the present and rising generation to crown the labors of the pioneers by attaining the highest peak of surgical success as we see exhibited in the achievements of the last few years.

There are two phases of embolectomy that the Swedish surgeons have especially developed. One is the dramatic and heroic

operation that Trendelenburg, of Leipzig, devised and first applied in 1908, twenty-two years ago, for the extraction of massive obstructing emboli of the pulmonary artery which, with increasing frequency, contribute to postoperative morbidity and mortality; and the other is the operation of embolectomy for the removal of obliterating clots in the peripheral arteries. In both of these procedures the Scandinavian surgeons have set an example that is now serving as a stimulus and encouragement to the surgeons of other countries to repeat their performances. According to Prof. Einar Key, of Stockholm, himself the foremost exponent of the surgery of the peripheral arterial emboli, 216 embolectomies for the removal of clots in the main surgical arteries, including 11 for clots in the abdominal aorta, had been recorded in the world literature up to 1929, and of these, 146 or practically 68 per cent had been performed by the Scandinavian surgeons, Key himself having contributed 15 of these experiences with 8 recoveries, including one successful aortic embolectomy. When we remember that the first embolectomy was performed by Ssbanejew in 1895, thirty-five years ago, and that during the years that followed (to 1911) only 11 embolectomies or thrombectomies, as they were then called, had been recorded in the literature, that up to that time only one patient had recovered (Lahey, Boston), and that the number of recorded operations has since increased to 205, with 146 of these to the credit of the Scandinavian surgeons, we have good reason to believe that this operation has become a specialty in their hands. This fact is emphasized by Pemberton's (Mayo Clinic) statement that up to 1927 only 20 embolectomies had been recorded in the United States, Canada and Great Britain.

The success of the Scandinavian methods is not due solely to their excellent technic, which is practically the same as that laid down by Carrel for arteriorrhaphy, with the free use of sodium citrate solution as an anti-coagulant, but it is in their alertness

in diagnosis and in their promptness to act on the diagnosis that they excel. Their experience has shown that an embolectomy has infinitely better chances for success when performed within the first ten hours and that beyond this time the recurrence of the clot is almost certain and the damage done to the peripheral circulation is irremediable. This is particularly true of the infectious emboli which are thrown out of the heart in septic endocarditis and other infectious diseases in which the embolus is the carrier of a microbial colony that sets up an endarteritis at the seat of embolic obstruction. When the operation is performed within a few hours after the artery has been obstructed, the permanent restoration of the circulation may be expected in as many as 50 per cent of the cases. The graver conditions in which the deobstruction of the arteries is performed in patients suffering from advanced endocarditis and as complications of other systemic infections and cardiovascular diseases, add greatly to the credit of our Scandinavian colleagues for their remarkable success (34 per cent recoveries in 135 operations performed within the first ten hours, Key).

But even more closely related to the postoperative complications that at present engage our attention is the encouragement that we derive from the experience and courageous enterprise of the Scandinavian surgeons in attacking the far more serious and forbidding problem of the acute massive and fatal emboli of the pulmonary artery.

In this performance they share the honors of a great surgical advance with their German colleagues who have persevered in the seemingly cheerless path laid out by Trendelenburg in 1908. Up to 1924, 20 cases of Trendelenburg's operation had been reported in the literature, but it is probable that other unsuccessful attempts had been made which did not find their way to the medical press. All the cases reported up to that time ended

fatally during or shortly after the operation. The longest survival was Krüger's patient who lived five and a half days after the operation, when death occurred from a secondary empyema. Since 1924, a very decided change in the prospects of this operation has occurred and now the efforts of the bold pioneers have at last been rewarded by success. Since 1924, 7 successful Trendelenburg operations have been reported, one by Kirschner in 1924, one by Meyer of Berlin in 1927, two by Giertz and Crafoord of Stockholm in 1927, and in the same year another by Nystrom of Upsala. Two other patients were operated on by Nystrom between 1927 and 1928. One of these survived the operation thirty hours, and the other five hours. All these patients were *in extremis* when operated on and therefore the seven recoveries were virtually so many resurrections.

Performance of these operations has taught many valuable lessons; among these is the fact, ascertained by Trendelenburg and since confirmed by more accurate observations, that death does not occur instantly with the onset of the first symptoms as formerly believed. Of 20 cases that came under the observation of Giertz and Crafoord in which the time between the first symptoms of the attack and death was recorded, in only 3 did death occur in less than ten minutes, which is, theoretically at least, sufficient time for a trained surgeon in a well-organized hospital to perform the operation. That no more than 3 patients were actually operated upon is due, as these authors state, mostly to the traditional fear of the operation, the only one that can give hope to save life. In some cases the age, obesity of the patient and other existing complications (pneumonia, cardiovascular diseases, etc.) or previous minor attacks, restrained the surgeons from operating.

Another lesson taught by these experiences is the tolerance of the brain and medulla to a suppression of the circulation and respiration for a much longer period than was at one time deemed possible in

view of previous experimental evidence. L  wen and Sievers had set the time limit of survival after total occlusion of the pulmonary artery to two and a half minutes, which in rabbits could be experimentally prolonged by artificial respiration, oxygen and adrenalin, to seven or eight minutes. Trendelenburg had estimated forty-five seconds as the longest time for survival after a total occlusion of the pulmonary artery in the human subject. In Nystrom's cases the circulation was cut off sixty, sixty-five and, in the patient who recovered permanently, one hundred and four seconds. In Giertz and Crafoord's cases the constrictor was kept on the pulmonary artery for forty-five and sixty-one seconds, the whole procedure taking not more than six minutes (Crafoord).

The operation is usually performed without anesthesia, as the majority of patients become unconscious shortly after the attack. None of the patients showed signs of residual postoperative brain lesions when consciousness returned in from fifteen minutes to six hours after the operations, despite the prolonged suspension of the circulation and respiration. A successful Trendelenburg operation leaves no secondary cardiac or pulmonary lesions and the patients after recovery have remained in perfect health for years (Kirschner's patient over four years).

The operation seems to have gained full acceptance in Europe, particularly in Sweden and Germany where it is a regularly standardized procedure.

The operation has been much improved by Prof. A. W. Meyer, of Berlin, who recently visited the United States. He insisted on the importance of avoiding the pleura to prevent the collapse of the lungs from pneumothorax, a particularly serious complication in these circumstances and one which undoubtedly contributed to the mortality following the earlier operations performed by the original Trendelenburg method. He also allowed the pulmonary circulation to be reestablished while operating by resorting to

intermittent partial occlusion of the pulmonary artery. He modified the Trendelenburg instruments, and strikingly demonstrated the great value of adrenalin injections into the aorta and of the inhalations of CO<sub>2</sub> and oxygen mixture as a powerful respiratory stimulant at the critical moment when the respiration is arrested. A suction apparatus, which need not be of the Trendelenburg model, is essential and is of incalculable value in the extraction of the clot. The instruments required are in reality very simple and can be found or improvised in any well-equipped hospital. However, a Trendelenburg outfit modified by Meyer is desirable but not essential for the purpose. What is more important is that the surgeon who may be called to perform the operation should familiarize himself with the anatomy and the technic by repeated exercises on the cadaver and in the experimental laboratory. With this proviso, there is no reason why a well-trained surgeon should not perform the operation. It offers no greater technical difficulties than a cardiorrhaphy for a wounded heart or for the extraction of a bullet lodged in its chambers.

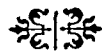
The Trendelenburg operation seems to be going through the historical evolution of all the great epochal operations. There is first the period of scepticism and doubt, then sporadic, tentative and often unsuccessful trials, and finally success and complete acceptance.

The life-saving limitations of the Trendelenburg procedure are obvious. At one time it was thought that one-half of the patients died within the first three to five minutes of the attack. More accurate observation has shown that the majority, on the basis of ten minutes' survival after the onset of the attack, could be operated upon; 20 out of 27 cases were regarded in Giertz and Crafoord's experience as operable under the most favorable hospital conditions. This, however, we must regard as a very optimistic view which may be theoretically correct but practically diffi-

cult, if not impossible to realize, even in the best hospital surroundings. The differential diagnosis at times may offer serious difficulties which justify hesitation and delay. In doubtful cases, Nystrom's suggestion to do a preliminary costochondral resection as preparatory to a later emergency operation and to do this under local anesthesia may be a helpful suggestion in the doubtful cases. However, it is significant that in 23 out of 27 cases that were under the observation of Giertz and Crafoord the clinical preoperative diagnosis was proved to be correct by either operation or autopsy. The worst prognostic feature is the possible recurrence of the embolus or the presence of multiple emboli broken up and lodged in inaccessible branches of the artery. But the 7 patients who have been saved within the last few years prove that the obstacles are not so great that many otherwise doomed patients cannot be saved and permanently restored to health and usefulness. There is no question that much judgment is required in the selection of cases. Nystrom has suggested that in patients suffering from other grave complicating diseases (cancer, tuberculosis, septicemia, etc.) and in the very aged and infirm, the operation would

probably only serve as a *coup de grace*.

The visits of Drs. Nystrom and Giertz, preceded a few weeks ago by that of Dr. Meyer, and their discussions of pulmonary embolism and its surgical treatment will no doubt help, in view of their great authority, to kindle a new interest in the Trendelenburg operation. This operation, though magnificently conceived in the fertile mind of its originator, had been followed by such discouraging results that, notwithstanding the early advocacy by Willy Meyer of New York and Matas of New Orleans, it was regarded in this country more as a matter of theoretical interest than of practical application. The recent achievements of the German and Scandinavian surgeons have brought the operation to the attention of the profession in a new light as a practical life-saving measure and have given it recognition as one of the most legitimate triumphs of modern surgery. It is hoped that the teachers in charge of the schools of operative and experimental surgery will take heed of this notable advance and make the practice of embolectomy and of the Trendelenburg operation an obligate part of the curriculum in the laboratories of operative surgery. R. MATAS.



## MEDICO-LEGAL PROBLEMS\*

WHENEVER someone feels inspired and impelled to launch an attack upon the administration of the law, the medical witness is quite apt to be one of his targets. The usual response of the medical profession is the charge that the situation is due to the laws, the lawyers and the judges and usually couples this with a suggestion that the laws and court procedure should be changed. While it is true that the laws and court procedure can be improved upon and that judges and lawyers could bring about a more efficient administration of the law even

without any changes being made in the laws, it is also true that the attitude of the public toward the testimony of medical experts is largely chargeable to the medical profession itself. I refer particularly to the major criticisms that expert witnesses differ so radically in their opinions and that their testimony is so often unsatisfactory and unconvincing.

Differences of opinion between expert witnesses, when analyzed, are traceable to perfectly natural causes. Where two men, though technically qualifying under the law as medical expert witnesses, differ

\* An Address Delivered to the Los Angeles County Medical Association, February 20, 1930.

substantially in their qualifications of knowledge and experience, a difference of opinion may naturally be expected. Such a situation, properly handled by the court and counsel, will clearly disclose the proper weight to be given to the testimony of the respective witnesses. Improperly handled, the witnesses may appear to be equally qualified and the appearance of unjustifiable conflict of opinion thus created may be charged to causes not at all to the credit of one or both of the witnesses. In every phase of a court trial the skill of the lawyer, particularly that of the lawyer against whom an expert witness is produced, is a big factor in the weight which will be given to the testimony and this is especially true where the opposing counsel is distinctly less qualified. But a trial should not be determined by the skill of counsel. The judge should be more than a mere umpire ruling upon the objections of counsel. It should be his function to assist counsel in securing a fair presentation of the facts. He should also protect witnesses from unfair cross-examination and discourtesy of counsel and, when it appears that the counsel producing a witness has not placed his testimony fairly before the court, the court may and should ask of the witness those questions which will bring out the proof which the witness can produce. If a witness, posing as an expert, does not appear to be well qualified, it is not only proper but a true function of the court to inquire into his qualifications and the reliability and accuracy of his testimony.

As between experts of comparatively equal knowledge and experience a difference of opinion may be either honest or dishonest. It is a pleasure to say sincerely that in a trial experience of over a quarter of a century as a trial lawyer and a judge I have encountered but one medical witness who was not honest in the testimony he gave and he was thoroughly discredited at the trial. We may therefore dismiss the dishonest expert as a wholly negligible factor. Differences of opinion

between honest, qualified experts may well arise just as do honest differences of opinion between any two persons over the same set of facts. Particularly is this true in forensic medicine since it is rarely the case that the experts have at their disposal all of the material facts. Most differences of opinion between experts may be traced to a difference in the facts upon which the opinions are founded. Naturally each side of a lawsuit has a theory upon which it bases its contentions. Quite naturally the facts in the possession of the plaintiff include matters not known to the defense and information possessed by the defendant is often not known to the plaintiff. Furthermore there is a natural tendency for each party to minimize the facts which tend to support the theory of the opposite party and to lay too great a strength with the facts in his own favor. This tendency is quite prominently indicated by the statements of fact as furnished to the partisan expert. There is also a tendency to withhold from the expert those matters of information which are disputed or disbelieved. It quite naturally follows that the experts for the plaintiff receive a different statement of the facts than that which is received by the experts for the defense. Furthermore there is not always allowed to the experts for the adverse party the same freedom and latitude of examination which is afforded by the party to be examined to his own experts. To these factors must always be added the element that the experts hired by a party to diagnose his condition are more prone to believe his statements as to his condition and symptoms and the adverse experts are more likely to carry a suspicion of possible malingering. These elements and some others of more occasional character are inherent in the system of trial where each party provides his own experts. As suggesting a remedy or improvement let us consider for a moment as a concrete topic the insanity defense in a criminal prosecution.

Before the amendments to the California statutes relating to the defense of insanity, it was the usual thing for each side to have its own experts; the prosecution produced experts who were of the opinion that the accused was sane while those produced for the defense were of the contrary opinion. I have a suspicion that in some cases one of the parties failed to call as a witness an expert who, though originally employed, did not hold an opinion consistent with the theory of the party who sought his services. Under this form of procedure the facilities afforded the prosecution alienists were ordinarily not the same as those afforded the doctors for the defense. It was not at all an unusual occurrence to find defense counsel insisting on being present when the prosecution alienists examined his client, frequently, when present, interfering with and preventing a proper examination. In one instance an attorney for a defendant absolutely refused to permit an examination of his client by the doctors for the prosecution and did not consent to such an examination until after the trial had actually commenced and then only when informed by the prosecutor that, if he persisted in his refusal, the fact that he had prevented such an examination would be proved at the trial. Another factor which cannot be ignored when experts are employed by the respective parties is the influence, conscious or subconscious, which is likely to result whenever an expert is employed, especially when his employment comes from a lawyer of high standing in his profession and in whose honesty and sincerity the physician has full confidence. Quite naturally under the old system of procedure the trial, so far as the issue of insanity was concerned, became a contest of experts and lawyers and, in the heat of that contest it was to be expected that the experts would develop not only a tendency to become partisans but at times even became champions for their respective sides of the question. After all it is rather human to enjoy a good scrap.

Under the present law of California, where the court, immediately upon the entering of a plea of "not guilty by reason of insanity," appoints a committee of experts to investigate and inquire into the merits of the defense of insanity and to render a report to the court of their findings, it has been the experience that the experts appointed substantially agree in their conclusions and, where differences of opinion exist, they are reasonable differences of opinion, due to the manner in which the symptoms, history and other factors were viewed. While the present law has been in operation only since August 1929, it has been invoked with sufficient frequency to justify the belief that it will operate as well in the future as it has in the past and its success and practicability are chiefly due to the following factors: First, the experts are not selected by, or in any sense bound to or compensated by, either the prosecution or the defense. Second, the court in making its appointments is entirely free from any partisan desires in the selection of the experts but selects its commission from among those members of the medical profession whom it deems well qualified. Third, and perhaps most important, the experts are each given a full and equal opportunity of learning all about the case unhampered by the interference of counsel. Of especial importance to the medical profession is the fact that, since the experts are appointed by the court and hence are non-partisan, their testimony is more nearly accorded the weight to which it is entitled, for the jurors look upon the experts appointed by the court as somewhat in the nature of officers of the court and, as such, entirely free from any partisanship or interest in the ultimate outcome of the case. Under this new order of things also, the attitude of the attorneys has undergone a distinct change. Cross-examination has become more of an inquiry to elicit information in addition to that which was brought out on direct examination, rather than, as was the former usual practice, an attack directed against

the witness. Trial lawyers of ability are fully aware of the prejudicial effect of any effort on their part to attack or discredit an expert witness appointed by the court, virtually vouched for by the court. While both the prosecution and the defense retain their former right to bring in experts of their own choosing, in addition to those appointed by the court, it is apparent from the past experience that this production of partisan experts is most unlikely to occur. If partisan experts should be called in and a conflict in testimony should arise between them and the experts appointed by the court, all natural tendencies would cause the jurors to give greater weight to the testimony of the court appointed experts. It is believed by those who have closely followed the operation of the new laws relating to the insanity defense that they come closer to producing a just verdict or decision than was possible under the former procedure. A method of procedure which works so well in cases involving questions of psychiatry is certainly worth trying in all cases involving expert testimony. Even under the new law relating to the defense of insanity there is much room for improvement, particularly in the provisions relating to the selection of experts by the court. That provision which arbitrarily requires that at least one of the experts appointed must be connected with one of the state hospitals is particularly impractical in those counties far removed from any one of the state hospitals and it is always unwise to interfere with the full exercise of the discretion of a court, particularly in the matter of the designation of experts in whom the court has personal confidence. The law is also somewhat ill advised in that it requires the commission of experts to consist of two or three members. While the courts no doubt have the power to nominate more than three experts, it is mandatory that at least two be appointed. It is well known that there are cases in which the insanity of the defendant is so obvious that no

good reason can exist for the cumbersome and more expensive method which requires more than one expert.

Much as we may deplore it, the fact remains that the general public has a lack of confidence in medical testimony and that this sentiment exists in the minds of many jurors and, to an extent at least, in the minds of the judges. The fact that this impression is largely unwarranted does not alter the unfortunate situation. But, since it does exist, it must be met; as far as it is unwarranted it must be overcome, and, insofar as it is justified, an effort should be made to remove the cause. Until this is done, every medical expert called as a witness must not only give his testimony but must also overcome any prejudice which may exist in the minds of those members of the general public who have to pass upon his testimony. This handicap of prejudice is due in no small part to the errors of commission or omission of the expert medical witnesses who have gone before him and is not an inherent characteristic. In foreign countries medical testimony is given far greater consideration than it is in this country and the expert is looked upon by the court and jury as a man whose testimony will bring to their assistance the full benefits of modern scientific knowledge.

While the gaining of the confidence of the court and jury depends in no small measure upon the personality of the witness, his conduct and appearance upon the witness stand; the weight which will ultimately be given to his testimony depends most largely upon the impression which the testimony itself will create. The giving of expert testimony in court is an art which is not inherited but must be acquired. No physician can say with any assurance that he will not be called into court during the coming year to render some medico-legal service and still, unless he be one of the rare few who, by study or consideration or actual experience or their combination, have learned the art of giving expert testimony,



the chances are that, if he is called, he will not only fail to do himself justice but will not render that degree and quality of service which modern medical science can bring to the assistance of the court. While this must naturally follow where the doctor is not possessed of a sufficiently thorough and accurate knowledge of the subject involved, a similar result follows where, even though the physician possesses the necessary skill and knowledge of the medical question involved, he lacks a knowledge of the manner of solving the question referred to him both as to the manner of conducting his investigation and as to the manner of testifying after he arrives in the courtroom.

The skillful trial lawyer is always mindful of the fact that a jury is composed of average citizens of the community to whom the matters and subjects involved in the trial are largely new and novel. Consequently he directs his efforts not only to the end of proving the facts making up his case but to proving them in so clear and conclusive a manner that every juror not only understands every word of the testimony but is convinced thereby. More than half of the verdicts of juries which have been criticised as being an unjust determination of the issues involved are more properly chargeable to the manner in which the lawyers and witnesses performed their functions in the courtroom. Both the witnesses and counsel must constantly take into consideration that the jurors are just average citizens, that their duties as jurors are most likely different from any experience they have had theretofore, that many of the facts in the case involve matters of knowledge which are entirely new to at least a portion of the jury and that the witness is rather an educator than merely an individual stating ultimate facts. It is not at all unusual, when discussing with a juror the facts of some case in which he served, to find that he had arrived at a conclusion on the facts not warranted by the testimony as that testimony would

be analysed by a trained and experienced judge or lawyer. A careful examination and review of the testimony will usually disclose that the real fault lay, not with the juror, but with the manner in which the proof was introduced. The average witness is so familiar with the subject matter of his testimony that he wholly overlooks that he is relating something which is wholly new to his hearers and fails to pay any consideration to the fact that the very purpose of his being on the witness stand is to transfer his knowledge to the minds of the jury. Thus a physician and surgeon who has examined the person of a litigant for the purpose of testifying to his physical condition is quite likely to come into court and testify to his findings in much the same manner that he would report the case to a group of doctors. To aggravate the situation the lawyers, desiring to display their knowledge of medical science (quite often acquired by a brief period of reading of an obsolete textbook) conduct the examination of the doctor in much the same tune, with the results that the jury, unable to grasp what it is all about, directs its attention elsewhere and to something more interesting. This is due in part to the perfectly natural use of scientific terms by the expert. While not a part, except indirectly, of my topic, I should like to repeat what was said on a former occasion that every witness, be he expert or layman, should give his testimony in such language that it will be fully understood by every member of the jury. This must be particularly difficult for the expert witness for, in spite of all that has been said on the question, our experts still testify far over the heads of the jury. Where the proceeding is a trial or hearing before a judge without a jury it may be a delicate compliment to the court to use as technical language as possible, but the decision will be most likely to go to that side whose understandable testimony is most convincing. The ability to testify in non-technical language is and can only result from a



clear grasp and understanding of the subject coupled with careful thought and consideration before taking the witness stand. The expert must develop an ability analagous to that of the successful teacher or instructor.

The point, however, to which I desire to call particular attention here is that of the preparation of the subject matter of the testimony to be given. The expert must always bear in mind that the objective is not that he convince himself as to the ultimate fact or facts but that his efforts must be extended far beyond that point and must be directed to the production of proof so that the final judgment of the court in which the trial is had, shall be in accord with the facts, a result which can only be attained if the judge, or the jury if it be a jury trial, receives all of the proof necessary to such a determination. No judge or jury will accept the opinion of an expert witness merely because he declares it from the witness stand. The opinion should always be supported by the facts upon which that opinion is based. It must be anticipated that, before the expert leaves the witness stand, he will be called upon to give the reasons and basis for his opinion. It would surprise the medical profession if they knew how many of their brother physicians have failed to convince the court or jury because of the incomplete or unsatisfactory basis of their expressed opinions. Take a case in which the doctor has testified that, in his opinion, a defendant is suffering from a particular disease. When called upon to state the basis of his opinion it develops that his opinion is absolutely dependent upon the statements of the person examined and that the doctor's conclusion can, therefore, be correct only if the statements of the patient were true. This reduces the decision of the question of fact largely to the truthfulness of the patient's declarations to the doctor and, the defendant being a very much interested party to the action, it is but natural that the weight given the doctor's opinion is

ultimately determined by the credibility of the patient. This type of case occurs quite frequently. Not so long ago I received an opinion from a physician that a defendant who had been convicted of shoplifting, after about ten years of activity in that line of business, was suffering from kleptomania, his opinion being based entirely on the statements of the defendant that she didn't know why she had stolen things and had only stolen articles of small value. This same defendant had made statements after her arrest and had testified at her trial entirely at variance with her statements to the doctor; in other words his opinion was based on only part of the available information. I am satisfied that, had he heard the woman's testimony on the witness stand, he never would have formed the opinion that she was a kleptomaniac. In his private practice the physician is warranted in believing the statements made to him by the patients who come to him for relief. They are not viewed as possible malingerers but are credited with sincerity even though it should ultimately develop that their ills are largely or wholly imaginary. But, when the patient is a party to a lawsuit or criminal prosecution, every effort should be made to guard against being imposed upon by a statement of facts and symptoms which have no basis in fact. Some years ago one of our well-known psychiatrists was appointed by the court to examine a prisoner in jail and later took the stand and testified that, in his opinion the prisoner was insane. Shortly thereafter the same prisoner came into court and pleaded guilty to two robberies, admitted that he had not had any of the symptoms upon which the doctor had based his opinion and that, so far as the objective symptoms were concerned, they had been feigned and then laughed over the way he had fooled one of the doctors. I must admit that this prisoner was one of the most clever malingerers I have ever met and his simulation of insanity was nearly perfect. The fraud was exposed only by

going beyond the prisoner's own statements and appearance at the time of the examination. The interested party in pending litigation may be an out-and-out faker or merely an unconscious malingerer; but such possibilities always exist and must be guarded against. The legal profession is well aware of the fact that the client who will give a fair, accurate and unbiased statement of the facts is an extremely rare individual. It seems almost inevitable that a client, like a young man courting a girl, will put forth in somewhat magnified form everything in his favor and entirely overlook or at least minimize everything to the contrary. This desire to exaggerate is well illustrated by a recent occurrence in a case in which a defendant desired to be released on bail pending an appeal after conviction of a felony. To support his claim that confinement in jail was imminently dangerous to his life, affidavits of physicians were filed in one of which appeared the statement that every meal taken by the prisoner after his commitment to jail several months previous had been forced. The testimony taken upon the hearing showed that there had not been a single instance of forced feeding. In the same set of affidavits it appeared that the statements as to the prisoner's weight as given by him were changed after the affidavits had been signed because it was discovered before the affidavits were filed that such statements of weight were not correct. To an ordinary person it would appear that the accurate way to get a man's weight is to weigh him and not accept his statement where weight is a factor in a diagnosis. What has been suggested in relation to the statements of the interested party himself applies largely to statements of friends and relatives. It is surprising how many conclusively insane acts of a defendant are discovered after he has murdered someone. Statements as to family history and past history of the patient, even in private practice, are very likely to be inaccurate or unreliable. People really know very

little about the cause of death of an ancestor or relative; what information they may once have had may be forgotten or, if not forgotten, may originally have been erroneous. This latter situation is quite likely to exist where the actual cause of death or a contributing cause of death is one of those diseases which people prefer not to mention. In addition to these possible defects in the statements of friends and relatives of a party to litigation the doctor must also guard against direct falsehood uttered to assist the litigant. One would hardly expect that the ordinary person charged with a crime could possibly feign insanity and still we have had instances right here in Los Angeles of prisoners who have so successfully feigned the symptoms and appearance of the insane as to fool able psychiatrists. In making this statement I have no reference to those cases in which the only proof of the absence of insanity is the verdict of a jury, but have in mind those cases in which the fact of malingering was conclusively established. If a man of the criminal type can so effectively simulate insanity with its complexity of symptoms, the possibility of a party to a lawsuit feigning a simpler ailment is apparent. The medical expert owes it not only to the courts and the interests of justice to use every possible precaution against deception but is obligated to the members of his own profession to do so lest, should he be deceived into giving an opinion not warranted by the actual facts, he cast discredit upon expert medical testimony in general. The attitude of the public toward the medical expert which now exists is based upon what it has heard and observed of the conduct and testimony of medical experts in the past. This attitude is largely unjustified, especially in so far as it is based upon the facts that experts have given diametrically opposed opinions and, in so far as it is justified it should be limited to those members of the profession who are no credit to it. The remarks in this discussion are largely directed in an effort to point out a means

of eliminating much of this adverse criticism in the future. Every time a physician and surgeon renders medico-legal service it should be of so high a character that it will be a credit to medical science. This means careful study, research and preparation, and a high sense of loyalty and devotion to his profession.

One of the minor contacts between the doctor and the court arises when a patient requests his physician to provide him with a very necessary certificate of disability to explain or excuse his attendance in court, the patient usually expecting a certificate containing as much evidence of trauma or pathology as possible. Having seen a goodly number of certificates of this character I am firmly convinced that the medical profession is not only extremely ignorant of the legal requirements but also rarely, if ever, considers the impression which the certificate will leave with the judge to whom it is ultimately presented. We are all aware and appreciative of the psychological effect of a well written letter on good stationery and, if we gave the matter a moment's thought, we should realize the effect of a hastily scrawled certificate written on a prescription blank. To make matters even worse the actual information which such a certificate should contain, the facts about the patient, are often conspicuous by their absence and the certificate consists usually of no more than an expression of the doctor's opinion as to how long the patient will be incapacitated. Add to all this the chances that the doctor is not known to the judge and it doesn't require higher mathematics to figure out the weight which the certificate will carry. Again, it not infrequently occurs that the certificate unjustifiably represents a condition which does not in fact exist. This is not due to any desire on the part of the physician to mislead the court but because he too carelessly accepts the statements of the patient and predicates his certificate upon those statements. In other instances a physician is called in

for virtually the sole purpose of securing a medical certificate from him. Not so long ago a defendant in a criminal case failed to appear in court when required and his attorney presented a medical certificate which his client had sent him. The certificate stated that the patient was suffering from nephritis and prostatitis, was confined to his bed and could not possibly be in court for at least several weeks. The district attorney knew the defendant better than did the doctor and sent two police officers to the defendant's residence to check up on him. They found the defendant up and about without any signs of any disability and on his desk found a letter to a pal, just completed, telling him how he had fooled a doctor into giving him a medical certificate and thereby evaded going to court. The defendant was taken to jail on a bench warrant and, though thereafter kept in jail to insure his presence when required, displayed no marked symptoms of any incapacity. An examination of the physician disclosed the fact that he had seen the patient on but one occasion and that his certificate had been based on what the patient had told him. It does not require many such experiences before a judge looks upon a medical certificate with considerable suspicion unless he happens to know the physician. The only safe course is never to certify to anything that would not be stated in the same manner under oath. Every such certificate should give an accurate picture of the case, stated in plain language, and, when the certificate contains a statement of the probable duration of the incapacity, the reasons for such opinion should be stated. This will entail special effort but then the impression created by a certificate is normally proportionate to the effort displayed. It must be borne in mind in this connection that proof in any court proceeding must be under oath and that the acceptance of an unverified certificate is a matter of courtesy on the part of the court.

In all matters of any particular importance the medical certificate should be in the form of an affidavit and sworn to before a notary or other officer authorized to administer oaths. The affidavit should contain a statement of the doctor's special qualifications as that will largely determine the weight which will be given to his statements and should conform to the suggestions elsewhere made in connection with the subject of oral testimony. It is the common practice for the lawyer to draft the affidavit for the doctor, but if this be done, it should be carefully edited by the affiant. The better practice would be for the doctor to personally prepare the body of the affidavit.

There is one class of cases in which the doctor is called upon to treat or examine a patient or to conduct a post-mortem examination and which eventually become the subject of a trial in court. While the probabilities of the resulting trial can usually be anticipated from the nature of the case it is the rule rather than the exception that the doctor makes no special preparation for his eventual appearance in court. When he does arrive in court we frequently find that his memory is extremely hazy as to the conditions and facts of the case and that his personal records are so incomplete that they are useless as a memory refresher. The law makes it a misdemeanor for any physician and surgeon to fail to immediately report to the local police or to the sheriff if the case be outside municipal boundaries, every case handled by him in which the patient is suffering from an injury caused by a deadly weapon or by a violation of any penal law of this state. This report must state the nature and character of the injuries but, in spite of the obvious wisdom of the requirement, we find only a limited compliance with its provisions, the average report being most meager in its statements of fact. Even independent of the law the minor as well as the major injuries should be carefully noted, not because of their

medical but because of their medico-legal and evidentiary value. A few minor scratches on the forehead of a man arrested for driving an automobile while under the influence of intoxicating liquor may be of no interest to the police surgeon who is giving him a test for sobriety; but when the doctor arrives in court he is apt to find himself being asked whether he noticed the injuries to the defendant's head and usually his testimony is that he is unable to state whether any such injuries were present. By the time the trial ends we find the defendant contending that his unsteady condition was due to head injuries received in the collision, a contention which the doctor would have been able to disprove or verify had he performed his full duty. As a police surgeon he should have anticipated that very common line of defense and be prepared to give all the ascertainable facts when called for, not only because of their evidentiary value, but because the admission that he does not know whether the defendant had any head injuries tends to show that his examination was not thorough and his evidence is consequently discounted. In a case of the character last referred to and recently tried, the police surgeon testified that he had no knowledge that the defendant had suffered any injuries when the fact was that he had suffered a fracture of several ribs. In examinations for sobriety the element of thickness of speech is a distinct factor and the defendant quite often endeavors to account for the thickness of speech by claiming that his speech is normally thick and indistinct, that his nationality gives him such type of speech, that he was dazed by the accident or that he had a new set of false teeth. I am still awaiting the testimony of a physician in such a case, differentiating the speech of an alcoholic from defects of speech from other causes.

The location, direction, size and appearance of wounds are of distinct importance in the prosecution of the assailant,

but the private practitioner usually has only the most indefinite recollection as to these matters. Recently a doctor testified in one of our courts to treating a boy who had been shot through the abdomen but was unable to tell whether the wound was on the right or the left side. Naturally juries will discount the testimony of a doctor who is unable to give the information which he should be able to furnish if his examination were thorough, especially as to so obvious and important a fact as the location of the bullet wound. Even in cases of post-mortem examination we find at times a lack of scientific precision. An autoptical examination such as would be made by a first-year medical student is not up to the standard expected of a graduate physician. Some years ago two of our local doctors were present and participated in the post-mortem examination of a man who had been shot to death. During the trial for homicide which followed it became important, as tending to prove the positions of the deceased and the accused at the time the shot was fired, to prove the exact location of the entrance and exit wounds. Both doctors testified positively as to the exact location of the bullet holes, but one of them placed the exit wound six inches higher up on the back than did the other. The district attorney had to exhume the body to settle the question. In another case the lip of the deceased was found cut entirely through. The nature of the instrument causing this particular injury was very important but the autopsy surgeon was unable to express an opinion as to whether the wound had been caused by the sharp edge of a knife or by a blunt instrument like the butt of the handle of a butcher knife. In still another case the autopsy surgeon testified that he had performed an autopsy and that death was due to a gunshot wound of the chest passing through the heart but admitted on further questioning that he did not know what part of the heart the bullet had passed

through. Instances of this kind of testimony, and others might be cited, are and have been an important factor in the formation of the regard in which the public holds the medical expert witness.

Much of the cause for the failure of the doctor to be able to give all the details which a thorough examination would have disclosed is the fact that he stopped as soon as he had performed his functions as a physician or had ascertained the cause of death and overlooked his function as a medico-legal expert. Whenever a physician has any reason to believe that he may later be called into court as a witness, his examination and observations should be conducted with scientific accuracy not only as to the principal subject of his attention as a physician, the condition requiring medical or surgical attention, but to every physical sign which could by any possibility be of evidentiary value even though it be a mere scratch. And, since human memory is fallible, these facts should be carefully and fully recorded in a notebook, supplementing the written word by a diagram whenever possible. Such a record is not only valuable for the purpose of brushing up the memory before going into court but the law permits the doctor to consult such a memorandum while on the witness stand for the purpose of refreshing his memory.

When a physician is called in as a medico-legal examiner to examine an individual for the purpose of establishing a fact by the application of the resources of medical science, he should bring to bear upon the problem the highest degree of skill, knowledge and accuracy of detail of which he is capable. This one subdivision of our subject is itself so extensive as to merit a lengthy presentation and citation of illustrations, but this occasion permits of but a single illustration. Let us consider a charge of rape. While there are not many cases of rape accomplished by means of force or fear, most states punish what is known as statutory rape in which the lack of consent of the female is not an

element of the crime, the offense consisting in the commission of the sexual act with a female under a certain age, eighteen in California. In either class of case one of the important facts to be proved is that an act of sexual intercourse took place and in nearly every case the prosecutrix is turned over to a physician for examination for the purpose of obtaining medical testimony on this issue. If an experience of about ten years in the office of district attorney supplemented by about two and a half years as judge presiding over criminal trials were my sole source of information, I would be forced to conclude that all that medical science can do towards determining whether a female has had an act of sexual intercourse, unless pregnancy or venereal disease is present, is to determine whether the hymen has been ruptured and whether the rupture is recent. Even here the doctor must admit that a ruptured hymen may result from causes other than sexual intercourse. During this twelve or more years of experience there were only two cases in which spots on the clothing were examined to determine whether spermatozoa were present; but even a positive finding from such an examination would prove only that there had been an emission and would not prove a penetration of the female sexual organs. It would seem logical that, since in completed sexual intercourse millions of spermatozoa are introduced into the vaginal tract, medical science could discover the presence of a few of them if an examination were made within a reasonable time after the sexual act and that their absence upon an examination shortly after an alleged act would have the tendency of rather conclusively proving that such an act had not taken place provided that the absence of spermatozoa was not accounted for by some additional factor. The answer as to why such examinations are not made would be interesting. So also would be an explanation of the testimony of three doctors in a recent case. Each testified

to having examined the prosecutrix; one testified to finding the hymen ruptured, a second that the hymen had not been ruptured and the third testified that he could not determine whether the hymen had been ruptured or not.

Whenever a doctor starts out to discuss the subject of expert medical testimony we may confidently expect that before he concludes he will have criticised court procedure and the rules of evidence. Some of this criticism may be justified but most of it is due to a lack of knowledge or misunderstanding of the law. Criticism of the law by a doctor who is not familiar with its provision may satisfy his personal feelings but gets us nowhere. It is interesting to note that most of the criticism comes from the doctor whose knowledge of the law is based almost entirely upon personal experience in the courtroom. It is undoubtedly often true that the expert medical witness leaves the witness stand with a feeling that he was not permitted to give the testimony he had expected to give. This may have been due to the fact that he did not know how to testify but is more likely attributable to the fact that the lawyer who called him as a witness did not know how to bring out his testimony. The percentage of lawyers who do not know how to put on expert medical testimony is fully as high as that of the doctors who do not know how to testify. Dr. Edward Huntington Williams has given us an excellent contribution on this subject in his recent book, "The Doctor in Court." Dr. Paul E. Bowers, also a member of your association and one who has studied law, at a joint meeting of the Los Angeles Bar Association and the Los Angeles County Medical Association in November 1928, also discussed the expert witness in an able but all too brief address which was later published,<sup>1</sup> and, in concluding, suggested that the two learned professions make a real effort to cooperate in a solution of the problem. Without a mutual understanding of the

<sup>1</sup> *Inter. Clin.*, s. 39, vol. 3.

respective viewpoints of the two professions of law and medicine the problems cannot be solved, for many of the problems are the direct results of misunderstandings. Meetings attended by members of both professions at which the subject is discussed will do much toward improving conditions, but the discussions must be frank as well as friendly even though at times the frankness may not be alto-

gether pleasant. Above all there must be an individual willingness and desire to study the problems and an individual effort on the part of every doctor to make the medico-legal expert just what the term implies.

CHARLES W. FRICKE, J.D., LL.M.  
Judge of the Superior  
Court of Los Angeles  
County, Calif.



## FLUOROSCOPIC CONTROL OF FRACTURE SURGERY

**D**URING the last decade surgeons have developed a commendable increase in interest in the radiosopic control of their traumatic work, especially during the actual setting of fractures. In a few large hospitals where there is much of this work to be done, the x-ray department has been equipped with a special room and a special table for this type of fluoroscopy permitting simultaneous observation in two planes, always depending upon trained medical personnel from the x-ray department to do the fluoroscopic work. The example set in these large, well-equipped hospitals has been contagious, and very naturally there has resulted a commendable desire on the part of surgeons generally to utilize the fluoroscopic control in their fracture work. Unfortunately, the majority of hospitals, especially the smaller ones, do not have the full-time services of a physician radiologist, so that many surgeons either by choice or by force of circumstances have come to do their own fluoroscopic observations, usually with a radiological technician turning the current on and off at the command of the observer.

The advance in traumatic surgery represented by this screen control of the setting of the fractures is not without its dangers, however, especially in those cases where the surgeon prefers or is obliged to do his own fluoroscopic observations. Radiological technicians are not, and by the very

nature of things cannot be, expert in radiology. They are not physicians and at no time in their work or training do they have opportunity or need of equipping themselves to do fluoroscopy. Hence, all that the technician can do in connection with fluoroscopy of fractures is to start and stop the current at the behest of the surgeon. Very few physicians not specializing in radiology have any definite idea of how much x-radiation can be safely administered at one sitting; indeed, few have any definite conception of how much radiation is being received by the part per minute. The chief advantage of the foot-switch, with simultaneous control of x-ray and overhead light, as introduced by the writer into fluoroscopic work in 1908, lies in one's ability to keep the current off at all moments the eyes are not intently fixed on the screen and ready of immediate observation. The current should never be on one single second uselessly, that is, when the observer is not alert and ready to look. This means that the observer will make no attempt to fluoroscope the patient until he has been in darkness or very obscure light for at least fifteen minutes; for any attempt to use the screen sooner will require a much higher milliamperage than is necessary or safe. With a foot-switch of this sort adequately used the actual dose of x-rays received by the patient may be reduced threefold or fourfold. A sheet of aluminum of 1 mm. thick-

ness should be fixed in place between the tube and the patient for all screen work. In fact, it is best to leave it in place for all kinds of diagnostic work, whether by film or by screen.

The writer has been surprised at the apparent carelessness with which he has seen the occasional radiologist subject

patients to prolonged fluoroscopic observation in connection with fracture or foreign body surgery. Many medico-legal cases involving the use of the x-rays have resulted from such unwise prolongation of the screen control. This word of warning should not be amiss.

JAMES T. CASE.



## FOR POSTERITY

THE portraits of men of achievement in any of the high professions should be painted by the worthy portrait painters of their country during their lifetime. While record of the actual work of our great men is carefully made and preserved the equally important contribution to history and posterity in the shape of a good portrait is more than often omitted. It is only when the famous doctor or engineer or philosopher or artist has passed on, that a regretful family seeks out a painter, presents him in most instances with a poor retouched photograph and begs for a lasting memorial of the departed husband, son or father who has labored faithfully for the advancement of his craft and the benefit of his community.

That photography has made tremendous strides in its artistic evolution no one will deny. Lighting, composition, fine printing are in many instances amazingly excellent, yet it is well to remember that after these attributes of a good photograph have been duly considered and accomplished, the mechanical click of the instantaneous shutter tells the final story.

The genius, the selective and observing brains of the well-equipped portrait painter are action of another and far more valuable

caliber in setting down the essence, in the subtle personality, the speaking quality, to use a trite but none the less expressive term, of a man.

How valuable too, to the institutions where these men of achievement have worked, is a collection of their portraits; how much better than all the biographies does a good painting portray them and help not only as fitting adornment for the walls of their workshops, but as an inspiration to their younger successors in carrying bravely on!

The two group portraits of Dr. Gross and Dr. Agnew in their respective clinics painted by the great Thomas Eakins of Philadelphia are interesting. Sargent's splendid group of Drs. Osler, Welch and Kelly of Johns Hopkins also comes to mind as does the recently painted group of doctors, ex-internes of the Lankenau Hospital, Philadelphia, surrounding Dr. John B. Deaver in his operating room, painted by Albert Sterner.

What finer gesture can be made by a college, medical society, hospital group or group of public spirited citizens than to have done, in oils by worthy painters, portraits of their physicians who have achieved unusual distinction! T. S. W.





## ABORTION AND CONTRACEPTION

*To the Editor:*

In response to your invitation to comment on the editorial by Dr. Gordon in your March issue, in which the doctor unhesitatingly condemns abortion and contraception, I wish to take issue with his stand. In Ohio we have a statute in accordance with which if three physicians concur in a decision that abortion is necessary to save the life of the mother, the production of such an abortion is legal. Many abortions have been induced in this state in accordance with that statute, and I think the statute has the approval of practically all our physicians.

When Dr. J. Whitridge Williams published the paper to which Dr. Gordon refers, I heartily approved of his attitude and promptly wrote him a note of congratulation over his frank and sensible attitude, and I have seen no adverse comment except this editorial by Dr. Gordon.

On general principles, to which, however, there may well be exceptions, as in some of the cases reported by Dr. Williams, abortions should be done only to save the life of the mother, or at least to save that life from extreme jeopardy. When it comes to contraception, however, conditions are different, and the judgment of the physician has a much wider range. I firmly believe in contraception in cases of mental and physical diseases which would probably be transmitted to the offspring, or in which pregnancy would be apt to affect deleteriously the life or health of the mother. There are many

other conditions which demand humane and intelligent consideration, and the decision as to advising contraception can be reached only after the exercise of well-balanced judgment.

I feel that every woman has certain personal rights in the matter of maternity, and I have never had any sympathy with surgeons who refuse to side-step the tubes to prevent future pregnancies in cases of cesarean section. I have made many such sections, but invariably I ask the woman and her husband as to their desires for more children by the same method, and if they express a wish that there shall be no more pregnancies I always side-step the tubes. In only two instances has the mother expressed herself against it: one of them had the tubes side-stepped after the second cesarean section, but the other still persisted in their preservation at the second section, but years have gone by and she has had no further pregnancies and is now well past that possibility.

There is one church which we are told absolutely forbids any interference with the life of the fetus, or in any procedure that shall prevent pregnancy; and I can easily understand how a physician brought up in the tenets of that church might oppose both procedures, but aside from that I see no reason why the wishes of the husband and wife should not be paramount. If any of my patients in whom I have thus side-stepped the tubes have regretted it, I have not heard of it.

J. F. BALDWIN, M.D.  
Columbus, Ohio.



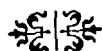
### FOUR INDEX NUMBERS A YEAR

This number marks the completion of the first volume of THE AMERICAN JOURNAL OF SURGERY since the increase in size in January, 1930. It comes to 1370 pages. As this makes a volume of unwieldy proportions, we will, beginning with July,

1930 (Volume IX), publish four volumes a year, instead of two, issuing indices with the September, December, March and June numbers. Consultation with librarians and subscribers has shown that this is a more desirable and practical method than to

attempt to continue only two volumes a year. It is found that an increasing number of subscribers are keeping bound files of THE AMERICAN JOURNAL OF SURGERY.

These present a record of the surgical progress of the day, and the extra indices are published in the interest of our subscribers.



## THE AMERICAN ASSOCIATION FOR THE STUDY OF GOITER

ANNUAL MEETING 1930

JULY 10 AND 11, SEATTLE, WASH.

JULY 12, TACOMA, WASH., AND MOUNT RAINIER

Thursday, July 10

- 8:00—Registration, etc., at the Olympic Hotel
- 9:30—Address of Welcome. HON FRANK E. EDWARDS, Mayor of Seattle
- 10:00—President's Address. DR. E. R. ARN, Dayton, Ohio: Auricular Fibrillation Associated with Hyperthyroidism
- 10:30—JOHN MARTIN ASKEY, Los Angeles: Blood Pressure and Goiter, a Preoperative and Postoperative Study
- 10:45—E. P. SLOAN, Bloomington, Illinois: Anatomy of the Thyroid Region
- 11:00—WM. ENGELBACH, Santa Barbara, Calif.: Simpler Diagnostic Methods of Endocrine Disorders
- 11:15—W. O. THOMPSON, Chicago: Course of Exophthalmic Goiter Following Subtotal Thyroidectomy
- 11:30—LEROY LONG, Oklahoma City: Some Remarks on the Management of Hyperthyroidism
- 11:45—RAYMOND J. MILLZNER, Oakland, Calif.: Parathyroid Studies
- 1:00—LEO P. BELL, Woodland, Calif.: Tumors of the Neck Simulating Goiter
- 1:15—C. A. ROEDER, Omaha, Neb.: The Third Type of Toxic Thyroidism
- 1:30—MARTIN B. TINKER, Ithaca, N. Y.: Thyroiditis
- 1:45—J. RUDOLPH E. SIEVERS, Butte, Mont.: Influences Bearing Upon End Results in Goiter Treatment
- 2:00—E. P. McCULLAGH, Cleveland: Relationship of Carbohydrates to Calcium and Phosphorus Metabolism in Tetany
- 2:15—GORDON S. FAHRNI, Winnipeg, Canada: Effects of Thyroidectomy Upon Pregnancy
- 2:30—WILLIAM J. KERR, San Francisco: Necrosis of the Heart and Liver in Thyrotoxicosis
- 2:45—GENERAL DISCUSSION
- 4:00—RALPH R. WILSON, Kansas City, Mo.: Effects of Thyroid Activity Upon the Female Organism
- 4:15—JOHN S. HELMS, Tampa, Fla.: The Incidence of Goiter in the Southeastern States and Its Possible Significance
- 4:30—H. W. RIGGS, Vancouver, B. C.: Adenomatous Goiter
- 4:45—GENERAL DISCUSSION
- 7:00—Boat Ride

Friday, July 11

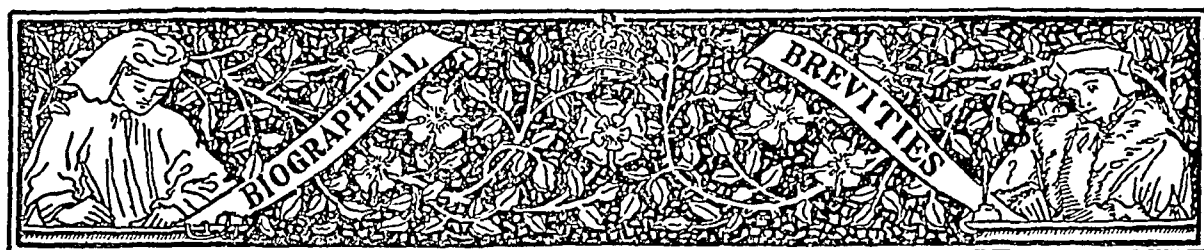
8:00 to 10:00—Surgical Clinics. Doctors BRIEN T.

KING, A. J. BOWLES, C. C. TIFFIN, J. TATE MASON, and J. C. MOORE.

- 11:00 to 12:00—HENRY S. PLUMMER, Rochester, Minn.: Thyroid Therapy
- 1:00—S. D. VAN METER, Denver: Classification of Goiter
- 1:15—THOMAS M. JOYCE, Portland, Ore.: Preparation of Thyroid Patients for Surgery
- 1:30—LEWIS M. HURXTHAL, Boston: Cardiovascular System in Goiter
- 1:45—NORRIS W. GILLETTE, Toledo, Ohio: Complications Following Thyroidectomy
- 2:00—THOS. O. BURGER, San Diego, Calif.: Local Anesthesia with Adjuncts for Thyroidectomy
- 2:15—ALLEN GRAHAM, Cleveland: Malignant Tumors of the Thyroid, a Study of End Results
- 2:30—WILLARD BARTLETT, JR., Saint Louis: Additional Method of Determining the Operative Risk in Goiter
- 2:45—J. EARLE ELSE, Portland, Ore.: Prevention of Postoperative Recurrences in Thyroidectomy
- 3:00—JOSEPH L. DECOURCY, Cincinnati: Rare Tumors of the Thyroid Gland
- 3:15—GENERAL DISCUSSION, Opened by WM. O. SWEET, Phoenix, Ariz.
- 3:45—ROBERTSON WARD, JESSIE L. CARR, San Francisco: Malignant Goiter
- 4:00—ADDISON G. BRENNER, Charlotte, N. C.: Hyperthyroidism and Hypothyroidism Following 2500 Thyroidectomies
- 4:15—LINDON SEED, Chicago: Differential Diagnosis of Thyrotoxicosis and Neurosis
- 4:30—GENERAL DISCUSSION
- 7:30—BANQUET. Address by KARL F. MEYER, San Francisco.

Saturday, July 12

- 8:00 to 9:00—Diagnostic Clinic: ARNOLD S. JACKSON, Madison, Wis.
- 9:00—EARLE DRENNEN, Birmingham, Ala.: Analysis of 125 Operations on the Thyroid Gland
- 9:15—O. P. KIMBALL, Cleveland: Relation of Endemic Goiter to Mental Deficiency
- 9:30—WARREN H. COLE, Saint Louis: Experimental Production of Pathological Changes in the Thyroid by Infective and Chemical Means
- 9:45—HENRY J. VANDENBERG, Grand Rapids, Mich.: How Long Is a Toxic Goiter Toxic?
- 1:00—Luncheon at Tacoma, with Pierce County Medical Society. E. STARR JUDD, Rochester, Minn.: Treatment of Peptic Ulcer and Gallbladder Disease Complicated by Hyperthyroidism T. ADDIS, San Francisco: Do Cases of Bright's Disease Have Disturbances of the Thyroid Gland? Dinner at Paradise Inn, Mount Rainier.



## “ADDISON’S DISEASE”

A COLLEAGUE of Richard Bright at Guy’s, known as an inspired pathologic lecturer and diagnostician rather than as a successful practitioner, Thomas Addison was born near Newcastle in 1793. He graduated in medicine at Edinburgh in 1815, after which he settled in London.

We are told his manner was repellent and haughty. However, this aloofness was a defensive mechanism to hide a shy and excessively sensitive inner-man. Because of these characteristics he never had a large practice. Perhaps it is well that this was the case. To his students and his hospital he gave unstintingly of the best that was in him.

He was decades ahead of his time in that he had little use for the polypharmacy of those days. It is said that he often left his patients forgetting to prescribe for them. However, “Addison’s pill,” composed of calomel, digitalis and squills, in certain syphilitic conditions is still prescribed.

Addison was the first to prescribe static electricity in the treatment of spasmodic and convulsive diseases (1837), and with John Morgan wrote the first book in English on the action of poisons on the living body (1829). He published an excellent account of appendicitis in 1839.

In 1837 he became physician to Guy’s Hospital. His chief researches were on pneumonia, phthisis and especially on the suprarenal capsules. He wrote on disorders of the female, and, with Dr. Bright, “Elements of the Practice of Medicine.”<sup>1</sup>

In 1849 Addison read a paper<sup>2</sup> describing pernicious anemia and diseases of the suprarenal capsules. These clinical articles were at a later date expanded in his great monograph, “On the Constitutional and Local Effects of Diseases of the Suprarenal Capsules.”<sup>3</sup> At the time this work was merely a scientific curiosity. It is now looked upon as epoch making.

Addison described a constitutional affection manifesting itself in an exaggeration of the normal pigment of the skin, asthenia, irritability of the gastrointestinal tract, and weakness and irregularity of the heart’s action; these symptoms being due to loss of function of the suprarenal glands. It was Trousseau who first proposed to call this suprarenal syndrome “Addison’s Disease,” by which it has been known to date.

Addison died at the age of sixty-seven years on June 29, 1860.

T. S. W.

<sup>1</sup> Vol. 1, 1839.

<sup>2</sup> *Lond. Med. Gaz.*, 32: 517, 1849.

<sup>3</sup> *Lond.*, 1855.





THOMAS ADDISON

[1793-1860]

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BIOGRAPHICAL BREVITIES  
"Addison's Disease"

*The American Journal of Surgery*  
N. S. Vol. vii, June, 1930





[From Fernellius' *Universa Medicina*, Geneva, 1679.]

# BOOKSHELF BROWSING

STUDIES IN PALEOPATHOLOGY XXV

## HYPERTROPHY IN THE SACRUM OF THE SABRE TOOTH, PLEISTOCENE OF SOUTHERN CALIFORNIA

ROY L. MOODIE, PH.D.

SANTA MONICA, CALIF.

**O**SSEOUS hypertrophy, as seen in the skeletons of fossil vertebrates, may indicate a variety of conditions. Pachyostosis is one of these and represents a non-pathological heaviness developed in the skeleton of vertebrates in response to a number of causes. This phase of paleontology is well known and has been so recently discussed that nothing more need be said about it here. Hypertrophy of bone accompanying a wide range of pathological conditions is also well known so it only remains for us to locate the present example of osseous hypertrophy in its proper place.

Examination of the figures will show that there is a necrosed area on the dorsal surface of the sacrum, to the right of Figure 1. I am going to state that, probably, the tiger to whom this pelvis belonged received a stab wound from the sabres of another tiger which having become heavily infected, resulted in the hypertrophic changes which are so evident in the specimen. The condition seen is thus interpreted as an example of osseous hypertrophy following a violent trauma, subsequently infected. The example is

quite unique and forms a striking object in the series of pathological pelves of the *Smilodon*. The last two lumbar vertebrae, firmly ankylosed to the sacrum, indicate that a slight scoliosis had developed as one of the changes due to the injury. The most striking change is the ossification of all the sacral ligaments, dorsal and ventral, accompanied by hypertrophic changes in the sacral and lumbar vertebrae themselves. I have sought eagerly for hypertrophic changes due to endocrine disturbances, but so far without success. A gigantic skull of a lion, one-third larger than any other lion skull in the collection, suggests pituitary changes; but a careful examination of the endocranial cavity is yet to be made.

The normal sacrum of the sabre-tooth has three vertebral segments, measuring in three specimens from 110 to 120 mm. in length. There are 1086 sacra of young and adult sabre-tooth tigers in the collections of the Los Angeles Museum, all of which I have examined. Only fourteen of them are pathological, and the present specimen is the most extensively changed of any of them. Even in old individuals

the sacrum is not preserved with the pelvic rami. Only three specimens retain this association and all of them are patho-

Changes due to disease are quite extensive in one specimen.

The most striking feature of the dorsal

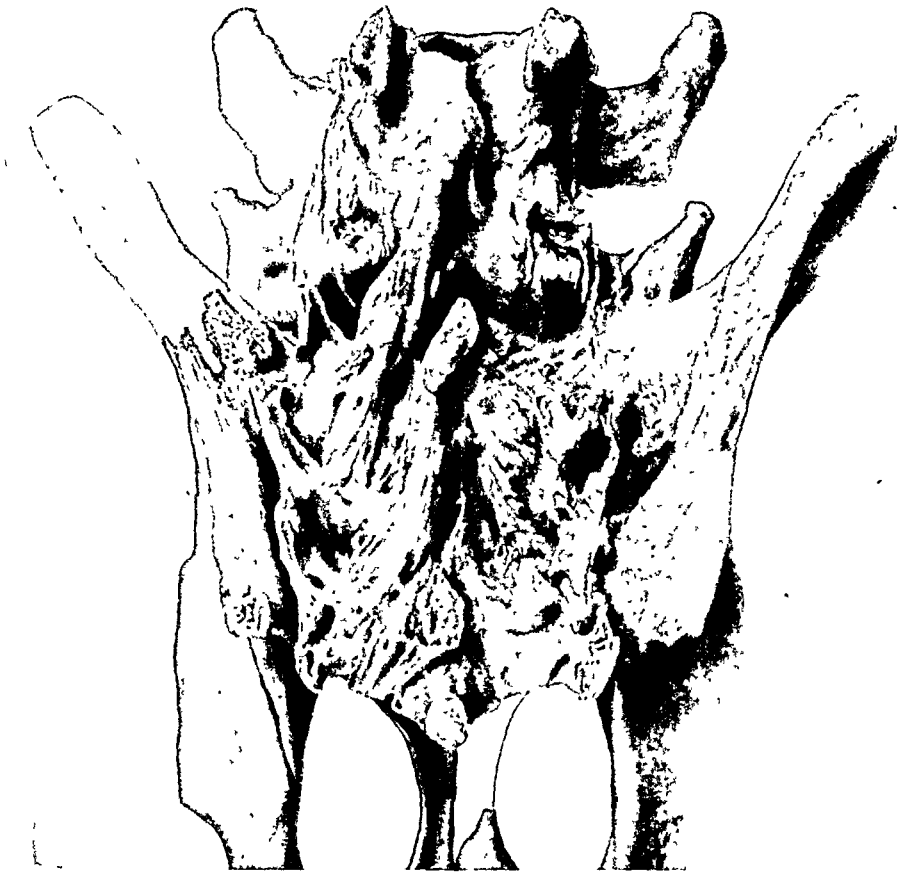


FIG. 1. Dorsal aspect of hypertrophied sacrum and pelvis of young, though mature, sabre-tooth (*Smilodon californicus*), showing intense ossification of ligaments, following injury, effects of stab wound received in right pelvis. Two lumbar vertebrae are firmly united to sacrum by ossified ligaments. Length of right pelvic ramus 320 mm. Left ramus was broken and part of it is lost. Length of vertebral mass, as preserved 160 mm. Sacrum proper is broken through middle of second segment. There is such firm coossification between sacrum and pelvis that a post-fossilization break took away part of each. Pelvis is otherwise unaffected. (Specimen in the Los Angeles Museum.)

logical. While there is some range in the length and width of the sacra none save the one here described exhibit hypertrophy. Five of them exhibit the phenomenon of sacralization which will be described in another paper.

Except for the slight pathological changes in the crest of the right ramus and its firm coossification with the sacrum and last lumbar, the pelvis is unchanged. A comparison with several pelvises shows a considerable variation in size. The acetabular cavities are unaffected. Pathological conditions in the pelvis of the sabre-tooth will be described elsewhere.

surface of the hypertrophied sacrum (Fig. 1) is the ossification of the vertebral ligaments, especially the Ligamenta interspinale, supraspinale, intertransversarium.<sup>1</sup> The differences between the right and left sides in the ossification of the ligaments may be explained by the presence of the abscess represented by the necrosed area on the right. There are a few blunt exostoses accompanying the ossification of the ligaments. The coossification between the pelvis and the sacrum is very intense.

<sup>1</sup> See Studies in Paleopathology. *Ann. Med. Hist.*, 8: 78; 288, 1926, for explanatory diagram.

Ossification of the ligaments of the lumbar vertebrae is not intense. The slight scoliosis is to be explained by the ossification of the ligaments on the left.

The sacrum had been broken, possibly during excavation, through the middle of the second sacral segment. The broken surface has a transverse diameter of 60 mm., and it is hypertrophied to more than one-third larger than normal. The neural canal is obliterated. This was not serious since, like the modern bob-cat, the sabre-tooth had a very short tail, and the last part of the sacrum contained a sort of cauda equina. The hypertrophy is ascribed to changes following upon a severe injury, subsequently heavily infected.

The ventral surface of the specimen (Fig. 2.) shows intense ossification of the ligaments, largely of the left side. The left transverse process of the last lumbar had been broken during life, and healed.

I think the appearances of the lesions indicate that suppuration had ceased before death. Except for a period of intense pain, following the infection, and some stiffness in the pelvic muscles the

activities of the animal would not have been interfered with by the results of the injury.



FIG. 2. Ventral aspect of same pelvis showing the ossification of ligamentum longitudinale. Anterior surface of lumbar vertebra is unaffected, so that pathological condition may be spoken of as spondylitis deformans.



## BOOK REVIEWS

THE DRAMATIC IN SURGERY. By Gordon Gordon-Taylor, O.B.E., M.A., F.R.C.S. 88 pp. 40 illus. N. Y., William Wood & Co. 1930.

The book with this most attractive title is based on an address delivered in Manchester, February, 1928. The contents, like the title, are delightful. There are forty splendid illustrations. As the author well points out "it is often for those morbid conditions which are *infinitely little* rather than for those which are gigantic or colossal . . . that the *most expert*, . . . but perchance the *least dramatic* surgery is really required," and further that: "perhaps Caesarean section proves the greatest source of attraction . . . though, of course not nearly requiring as much expertness as many an operation that would attract little attention on the part of the uninitiated." The author's own

dramatic instinct is indicated by his calling the foreign bodies, which are removed from the *corpus humani*, "trophies," and his reference to "surgical megalomania."

That "the dramatic in surgery may be attained alike by the *elaboration* or by the *simplicity* of the requirements which are regarded as essential to the art," should be impressed upon all students. Simplicity in surgery, as well as in all other arts, is undoubtedly the greatest and most difficult of achievements.

As the most modern touch, he mentions that "as a means of rendering 'first aid' the aeroplane may be valuable." Considering the arrival of the surgeon in an aeroplane as part of "the dramatic in surgery" is in itself rather good theatre.

Humorous instances are not overlooked by



our author and here, as elsewhere, the ubiquitous Scotchman is quoted: "A Scotchman walking down Charing Cross Road on the way to Charing Cross Hospital to have the hydrocele tapped, saw a sixpence on the pavement and stooped to pick it up; he ruptured the hydrocele and was brought to Middlesex Hospital instead."

It must not be thought for a moment that this book is only for amusement or pastime. It contains many an axiom that may well be taken to heart by even the most experienced surgeon, such as "This at least is certain: the most thorough co-operation of surgeon, physician, radiologist, and laboratory worker is necessary to decide the need of surgery and to determine the appropriate character of the operation to be performed." A small book, but well worth while.

*THE ACTION OF MUSCLE.* By Sir Colin Mackenzie, M.D., F.R.C.S., F.R.S., (Edin.), Ed. 2, 288 pp., 100 illus., N. Y., Paul B. Hoeber, Inc., 1930.

This is the second edition of this widely read work.

Since the Great War greater attention has been paid to the importance of muscle function, whether in the consideration of health or disease, than formerly. Physiotherapy today plays an important part in every modern hospital. In this new edition a special section has been added dealing with the erect posture. The author dealt with these principles in his presidential address before the Section of Zoology at the Australasian Science Congress in 1928.

After the introduction the book considers Principles, The Shoulder Region, The Biceps Brachii and Brachialis; Musculocutaneous Paralysis, Median Nerve Paralysis, Ulnar Paralysis, Musculo-Spiral Paralysis, The Muscles of the Thigh, Muscles Acting on the Leg, Muscles Acting on the Foot, The Muscles of the Toes, Muscles of the Spine, Muscles Which Move the Neck, Muscles Which Move the Back and Loins, Anatomical Considerations in Joint Fixation, The Muscles of Respiration. The book is well indexed and contains 100 illustrations.

Any doctor will profit by reading this important work but we specially recommend it to surgeons and neurologists.

*NEUE DEUTSCHE CHIRURGIE.* Begründet von P. von Bruns. Herausgegeben von H. Küttner in Breslau. 44 Band. *DIE CHIRURGIE DER BASEDOWSCHEN KRANKHEIT.* Von Dr. Heinrich Klose, Prof. der Chirurgie an

der Universität Frankfurt Am Main; Direktor der Chirurgischen Abteilung des Stadtischen Krankenhauses der Freien Stadt Danzig. 675 pp. mit 273 Teils Farbigen Abbildungen. Stuttgart, Ferdinand Enke, 1929.

45 Band. *DER WUNDSTARRKRAMPF BEIM MENSCHEN.* Von Dr. Arthur Buzello, Prof. an der Universität Greifswald. 276 pp. mit 51 Textabbildungen. Stuttgart, Ferdinand Enke, 1929.

46 Band. *CHIRURGIE DER MILZ.* Von Prof. Dr. H. Hirschfeld, Berlin und Prof. Dr. R. Mühsam, Berlin. 286 Seite mit 32 Teils Farbigen Textabbildungen. Stuttgart, Ferdinand Enke, 1930.

47 Band. *DIE HÄMOPHILIE.* Von Prof. Dr. H. Schloessman, Direktor der Chirurgischen Abteilung der Augusta-Krankenanstalt Bochum. 321 pp. mit 60 Textabbildungen. Stuttgart, Ferdinand Enke, 1930.

Four new volumes of the famous "Neue Deutsche Chirurgie" are before us and as usual each volume is a complete and up to date monograph on its particular subject.

Klose's book on "Basedow's Disease" is the largest of the four and especially well illustrated. With a controversial subject in hand, the author had a difficult time of it. In his Preface he explains that the book does not suit him completely, but that he has acceded to the pressure put upon him by both the editor and the publisher to produce the volume at once. The reviewer feels that the author is entirely too modest and that the book may well be accepted as a comprehensive and thoroughly scientific review of the present status of the etiology, pathology and treatment of this disease. His plea that the surgeon should always work in cooperation with the internist in the treatment of this condition is one that every American surgeon may well take to heart.

The volume by Buzello on Traumatic Tetanus covers, as the author states, one of the most important and terrible wound infections with which we have to deal. Tetanus is considered as a bacteriological infection and also as a nervous disease, so that the book will also interest the clinician. The author feels that as tetanus usually follows wound infection, its treatment will continue to be in the hands of the surgeon, especially as such an infection involves important and serious surgical operations. Here again, as in the other volumes of the series, the necessity for cooperation between the physician and surgeon is particularly stressed, even though the ultimate treatment is felt to be entirely surgical.

Hirschfeld and Mühsam take up the present status of the surgery of the Spleen. It is interesting to note that whereas this volume on

the Spleen has 286 pages, the volume on this subject in the "Deutsche Chirurgie" published in 1890 contained only 57 pages. In the last forty years progress has indeed been made in the surgery of the spleen, and its removal is today advised for many other conditions beside tumors of the spleen. Here again, as in the volumes mentioned here, the authors make a plea for the utmost cooperation between the surgeon and the internist. Up to the minute, thorough and profusely illustrated, this volume will be invaluable for reference to German reading surgeons.

Hemophilia is discussed in 306 pages by Prof. Schloessmann, who has had unusual opportunities for research in this condition during many years at Württemberg. This work contains an unusual amount of personal research and conclusions drawn therefrom, combined however with a complete study of the international literature on the subject. Like our American writers, the author feels that most progress in the prevention of this disease will come from a more thorough study and knowledge of eugenics. The book is fully up to the standards of the other volumes of this series.

All the volumes of the "Neue Deutsche Chirurgie" contain splendid bibliographies. It is to be regretted, however, that each volume has not a detailed index. They all have comprehensive table of contents, but a complete index would facilitate ready reference.

MODERN OTOTOLOGY. By Joseph Clarence Keeler, M.D., F.A.C.S. 878 pp., 90 original illus. and 15 colored plates. Phila., F. A. Davis Co., 1930.

There is nothing so difficult to review fairly as a textbook. It should bear the stamp of the author's individuality; at the same time it should not feature any of his hobbies too strongly. Like other methods of teaching, it is not a question of whether one agrees with the particular method used, but of the success attained in getting the subject across to students. Dr. Keeler recognizes this difficulty when he states that "During many years of otologic practice and preaching . . . I have always felt that the existing textbooks were unsatisfactory. Though their good points outnumbered their faults . . ." And he adds "When, occasionally, I voiced this dissatisfaction . . . the advice I usually received was: 'Write a book yourself.'" Now, of course, his own book must submit to the same attitude on the part of

others. The subject is completely covered, the illustrations are well selected and well reproduced; in short we have before us another good, conventional, textbook. That it will appeal to many teachers and students is certain; that it will not suit everybody is equally certain. Were there not differences of opinion there would be occasion for only one textbook on each subject, a condition that is often prayed for by teachers, students and publishers. On the other hand, the very variety of books, forcing critical selection, undoubtedly makes for better teaching, better textbooks, and better practice. Every otologist will want this book if only for comparison with others. The man having only one book on otology will not go far wrong if he selects Keeler's "Modern Otology," and the same could be said of several other books on the subject.

A SHORTER SURGERY. A Practical Manual for Senior Students. By R. J. McNeill Love, M.B., M.S. (Lond.), F.R.C.S. (Eng.) Ed. 2, 389 pp., 74 illus., including 31 plates (one colored). N. Y., William Wood & Co., 1930.

This book lives up to its title: "A Shorter Surgery." For a quick freshening up on the general subject for examination or otherwise this work should be valuable. The author states that it "is an attempt to condense and crystallise the more important principles of surgery for the benefit chiefly of the student." Whether it is too short for the student is a problem that the individual instructor will have to decide for himself. It appeals to the reviewer more as a quick reference for the experienced surgeon. In any circumstances it can be considered only a supplement to larger textbooks. The book is well illustrated.

THERAPIE UND THERAPEUTIK: EIN MAHN RUF AN ÄRZTE, KLINIKER UND PHARMAKOLOGEN. By Prof. Dr. I. Boas. vi + 79 pp. Verlag von S. Karger, Berlin, 1930.

It is encouraging to note that the great German precisionistic movement in science which swept through medicine during the last fifty years has at last embraced therapeutics. Dr. Boas makes an impassioned plea for scientific therapeutics studied under controlled conditions as immediately necessary if medicine is ever to get over the barren wastes of a traditional therapy. The plea is timely for Germany, where commercial exploitation is making a mockery of the treatment of disease. Thanks to the "therapeutic nihilism" of Osler and the weighty influence of the Council on Pharmacy and Chemistry of the American Medical Asso-

ciation, American medicine has long been developing a healthy interest in real scientific therapeutics. Dr. Boas might have used our experience to advantage in his thesis. At any rate, we may watch the effect of his "warning" with sympathetic interest.

STRAHLENBEHANDLUNG DER WEIBLICHEN GENITAL-CARCINOME, METHODEN UND ERGEBNISSE (Radiation Therapy of Female Genital Carcinoma, Methods and Results). By Prof. Dr. Friedrich Voltz, Dir. Radiotherapy Section, Gynecol. Clin. Univ. of Munich, with foreword by Geheimen Rat Prof. Dr. Albert Doderlein, Dir. Gynecol. Clin. Univ. of Munich. 57 colored illus., 8 colored charts and 40 tables. Berlin, Urban & Schwarzenberg, 1930.

This 206 page work represents a real contribution to our present knowledge of methods and results of radiotherapy in the treatment of genital carcinoma of women. The work done in this field by the Doderlein Clinic of Munich is well known to every gynecologist and radiologist doing gynecological radiotherapy. Professor Doderlein made his first very important report on this subject from his clinic in 1913 before the International Congress of Medicine in London.

There is a brief chapter on the development of radiation therapy of female genital carcinoma. The second chapter deals with the effort being made by the Hygienic Section of the League of Nations to forward the progress of the campaign against carcinoma. In fact this book really represents a report by Professor Voltz, as a member of the sub-committee of the League of Nations, Hygienic Department, appointed to investigate genital carcinoma in women.

The author gives a classification of carcinoma of the female genital tract, with many beautiful colored illustrations of the histological appearances, followed by a description of the roentgen apparatus for deep roentgen therapy, the apparatus for measuring dosage, and a description of the necessary supply of radium and radium applicators for gynecological radiotherapy.

The general method of treatment which is pursued at present in the University of Munich Gynecological Clinic is as follows:

*First day:* Examination of the patient, taking of the history, and study of the various clinical findings, and marking out of the various parts of entry ready for the treatment.

*Second day:* Radiation over the hypophysis. This was first suggested by Henry Hirsch and since the year 1923 has been part of the routine

treatment of all carcinoma patients in the Munich Clinic. The idea is to sensitize the carcinoma. The author has seen no disadvantage from this treatment; on the contrary he is quite convinced that the general condition of the patient has been very much improved during the radiotherapy. Two lateral fields are employed,  $6 \times 8$  cm. The focal skin distance is 30 cm. and the treatment amounts to 30 per cent of the erythema dose at 200 kv., with 2.5 ma. and 1 mm. of copper filter. This treatment is given only once at the time of the first series of treatment.

*Third day:* The patient is given an injection of "Dextrocid," following which the physician goes ahead with the general radiotherapy to the pelvis. This "Dextrocid" injection is an intravenous administration of glucose, which has been done routinely in all their cancer cases since 1927. It also was introduced by Henry Hirsch in Hamburg. The author claims to have seen beneficial results following this injection.

*Fourth day:* The fourth day is rest day. Sometimes more than one day is necessary.

*Fifth day:* On the fifth day is done any diagnostic work necessary, such as the excision of specimens, or of extrafoliating tissue, or the cauterization or cataphoretic treatment as may be necessary.

*Sixth day:* The sixth day is rest period which may be extended if necessary.

*Seventh day:* Glucose injection and treatment with radioactive substances.

*Eighth day:* The eighth day is rest day.

*Ninth day:* Discharge of the patient.

The second series of treatment occur after an interval of eight weeks from the day of the discharge of the patient. The third series may sometimes be given after another interval of eight weeks.

The result can hardly be reported in a review. The authors not only give their own results but they summarize the results published from numerous sources both in Europe and in America. They conclude by expressing the hope that this work, with its published results, will further emphasize the declaration of Professor Doderlein that the radical operation for uterine carcinoma is no longer justifiable.

Concluding chapters are translations of reports from the Radium Hemet of Stockholm by Heyman and from the Radium Institute in Paris by Lacassagne and by Regaud.

TRAITÉ DE RADIODIAGNOSTIC, Squellette en General (Tete-Rachis-Bassin-Membres). By G. Chaumet, Ass. Prof., Val-de-Grace, Paris. 202 figs. Paris, Vigot Frères, 1930.

This 350 page treatise on the x-ray diagnosis of bony lesions is the result of the author's belief that it is well to bring together periodically the well established facts and from them to take stock of our resources. To rejuvenate old ideas, to eliminate certain lines of effort which seem useless, to moderate enthusiasm for methods or theories which appear to be too popular, to offer a critical analysis of results in the light of experience, and to make a slight personal contribution, these are the reasons given by the author for his book.

All progress is achieved at a price. The perception of bones through soft tissues carries with it a certain number of illusions: the deformities, enlargements, superposition of shadows due to the conical projection of the x-rays, all the optical phenomena which lead to error. It is the duty of the radiologist to profit by investigation in new improvements of technic and by the employment of new positions and angles of incidence.

The patient presents numerous individual problems. The reading of the radiographic films cannot be correctly done without a certain familiarity with pathology. But even the best possible film cannot be judiciously interpreted by the most distinguished physician in the world if he lacks the necessary training.

The task of the medical radiologist rests upon a triple foundation: (1) Adequate radiographic technic; (2) abundance of experience in interpretation; (3) a broad medical training.

After a brief consideration of general principles and a chapter on the radiographic appearances produced by various morbid processes in bone, the author proceeds to a regional discussion of bony lesions as revealed in the radiographic films. There is an excellent outline for the study of bones. Numerous illustrations add value to the suggestions as to improvements of technic. Various positions are advised which, though not in common use, merit careful consideration and more frequent employment.

✓ GALLBLADDER DISEASE, Roentgen Interpretation and Diagnosis. By David S. Beilen, B.S., M.D., Roentgenologist, Augustana Hospital, Chicago. St. Paul, Bruce Pub. Co., 1929.

There is much about this work to commend it. There are large, well reproduced illustrations, rich in radiographic detail. The text,

though meager, presents the clinical and pathological facts in order, with the x-ray evidence as a series of films for each case. The work should prove helpful in the interpretation of oral cholecystography. The author dismisses with a few words the intravenous method as of little importance, although Graham and his associates, after many thousands of trials of both oral and intravenous administration of the tetraiodophenolphthalein, still emphatically advise the intravenous route as more reliable. As an exposition of the views of one who is entirely satisfied with the oral method and claims an unusually high percentage of operatively proved accuracy, this work is an admirable product.

TASCHENBUCH DER MEDIZINISCHEN RONTGEN-UND RADIUM TECHNIK. By Dr. Phil. Gottfried Spiegler and Dr. Phil. Albert Fernau, Leiter der Rontgentechnischen Versuchsanstalt am Zentralrontgeninstitut des Allgemeinen Krankenhauses in Wien and Privatdozent für medizinische Physik und Chemie des Radiums an der Universität Wien, respectively. 330 pp. and 63 illus. Wien, Julius Springer, 1930.

An excellent brief introduction to the practice of radiography and radium therapy. The book abounds in tables, formulae and rules for protection. There is much detailed information regarding minor points of technic included in this systematic consideration of the physical and practical bases of radiologic diagnosis and therapy.

X-RAY TECHNOLOGY, The Production, Measurements and Applications of X-Rays. By H. M. Terrill, Ph.D., Assoc. in Physics, Inst. Cancer Research and C. T. Ulrey, Ph.D., Research Physicist, Westinghouse Lamp Co. N. Y., D. Van Nostrand Co., Inc., 1930.

The authors state that in preparing this book it has been their purpose to present the practical rather than the theoretical aspects of x-ray measurements as they are inevitably encountered by all who choose to work in the x-ray laboratory. Much of the contents is devoted to problems common to all x-ray laboratories but particular attention has been given to the quantitative measurements involved in roentgen therapy and in the application of the x-ray to industrial problems. A considerable portion of the contents may be properly classified as x-ray engineering.

Properties of moving electrons are discussed in 25 pages, x-ray tubes and their operation in 50 pages, generators of high voltage in 20 pages. Pages 99 to 211 discuss measurements of voltage and current, ionization, total energy,

wave-length and biological problems. The remaining 40 pages are devoted to x-ray analysis and radiography, especially in its industrial applications.

This is a very readable, interesting book and well worth acquisition by all interested in radiology.

YOURSELF, Inc., *The Story of the Human Body*. By Adolph Elwyn 332 pp., 71 illus., N. Y., Brentano's, 1930.

The title of this book will undoubtedly appeal to those whom it is intended to attract. To the reviewer the sub-title "The story of the Human Body" is much more attractive but "wise-crack" titles seem to be the order of the day and if "Yourself, Inc." will draw additional attention to the story of the human body so much the better for the readers, for the author, the publishers and for the medical profession. The story is well told, accurate and definite, and may be recommended without compunction to every intelligent layman. Scientific facts are put before him in language that he will readily understand but which, at the same time, assume more common sense on the part of the reader than many authors of so-called "popular medical books" are in the habit of accrediting to him. The first chapter, regarding the title of which there seems to a difference of opinion between the caption writer and the index maker (for it is indexed as Looking Backward and the running head reads Looking Back), is a delightful fifteen-page abstract of the History of Medicine to the time of Vesalius and Harvey. The other chapters in turn are headed Introducing the Body, Concerning the Cell, The Living Membranes, The Building Trades and Their Strange Associates, The Transport Workers, The Pump and Engine Workers, The Engines of the Human Body, The Transportation System, The Food and Fuel Industries, The Utilization of Air, The Disposal of Garbage, The Central Government, The Central Government (continued), The Regulation of Home Activities, Concerning Reproduction, Looking Forward. The author is very apt in his ability to draw an analogy between the workings of the human body and those of machinery.

CHIRURGIE DES KINDESALTERS. By Prof. Dr. R. Drachter and Dr. J. R. Gossmann. 1047 pp., 714 illus., Leipzig, F. C. W. Vogel, 1930.

This new edition has been brought entirely up to date as is evidenced by the mention of

Intravenous Pyclography. Incidentally, attention is called in the Preface to the fact that the portion on the urinary tract has been completely revised. The illustrations, both colored and black and white, leave nothing to be desired, and the text of over 1000 pages covers the subject thoroughly and without padding. It is an invaluable book on Surgery in Children that is indispensable to every German reading surgeon.

THE INTERNATIONAL MEDICAL ANNUAL: A Year Book of Treatment and Practitioner's Index. Editors: Carey F. Coombs, M.D., F.R.C.P. and A. Rendle Short, M.D., B.S., B.Sc., F.R.C.S. 609 pp., 61 pl., 54 illus., N. Y., William Wood & Co., 1930.

The annual return of the International Medical Annual is as welcome as are the flowers that bloom in the spring. Particularly for the man who "has not the time" to keep up with the voluminous literature appearing each month, this annual resume of the advances in medicine is a boon. With the death in April of last year of Dr. Wilde, its founder and editor, the new volume has been taken up by Drs. Coombs and Short, as editors, and the old traditions have been well preserved. Unusually well illustrated, this volume forty-eight presents, as do the previous ones, a compact and reliable review of the medical and surgical advances of the year.

DAS FÜR UND WIDER DER CHIRURGISCHEN BEHANDLUNG DES GALLENLEIDENS auf Grund der Erfahrungen an 800 Gallenoperationen. By Prof. Dr. Paul Zander, Chirurg des Elisabethenstifts in Darmstadt. 95 pp., 8 illus., Leipzig, Georg Thieme, 1930.

This eighty-nine page consideration of the perennial discussion concerning the medical and surgical treatment of gall bladder diseases presents both sides tersely. It comes, as do all such discussions, to the inevitable conclusion that the ideal situation is honest cooperation between the internist and the surgeon. The debate of this subject will continue for a long time and it is interesting to have this resume which really presents the present status of the case.

MERCK'S INDEX: An Encyclopedia for the Chemist, Pharmacist and Physician, Giving the Names and Synonyms; source, origin, or mode of manufacture; chemical formulas and molecular weights; physical characteristics; melting and boiling points, solubilities; specific gravities; medicinal action; therapeutic uses; ordinary and maximum doses; incompatibilities; antidotes; special cautions; hints on keeping and handling, etc., of the Chemicals and Drugs Used in Chemistry, Medicine and the Arts together with an Appendix containing: reactions of the more important alkaloids

and glucosides; characteristic reactions of acids, bases, metals, and salts; table of atomic weights; thermometric equivalents; specific gravity tables; metric conversion tables; and abbreviations. Ed. 4, 593 pp., Rahway, N. J., Merck and Co., Inc., 1930.

The third edition of this work was published in 1907 and it is explained that the delay in the publication of the fourth edition "was caused largely by the complete interruption of work on the book in both laboratory and editorial rooms during the World War." That the book lives entirely up to its title (as given here) is perhaps the best description that can be made of it and it is a high compliment indeed. It is believed that the hope expressed in the Preface "that it will meet the needs of the student, the apprentice, the young man on the threshold of his professional career" will be entirely fulfilled.

**OBSTETRICS FOR NURSES.** By Joseph B. De Lee, M.D., Ed. 9, 645 pp., 269 illus., Phila., W. B. Saunders Co., 1930.

The new ninth edition of De Lee's *Obstetrics for Nurses* deserves its widespread popularity.

In this edition many new features are included. The book has been carefully revised, completely reset and contains hundreds of new illustrations.

One can understand why this is the standard textbook in the large majority of training-schools for nurses. We might add, the type of general practitioner who has little time for quiet study and reading, who is rusty in the ordinary fundamentals of obstetrics, can read this book with mental and practical profit.

**GYNECOLOGY FOR NURSES.** By George Gellhorn, M.D., 275 pp., 145 illus., 12 mo., Phila., W. B. Saunders Co., 1930.

This is a book that should receive a welcome in every training-school for nurses. It is a good book from every angle. Dr. Gellhorn is especially fitted to have done this work. He has taught nurses for over twenty years. He knows what a nurse needs in the performance of her duties. In his *gynecology for nurses* as held to the sane and practical. He has left out the pseudo-scientific hokum, so noticeable in many works for nurses that are made into big books by unnecessary padding.

This book covers the subject. It is easily read. Any nurse is sure to grasp the thoughts conveyed by the author. It has 275 pages and 145 illustrations. We do not only cheerfully recommend it but we urge that it be in the hands of every pupil nurse.

**DISEASES OF THE NOSE, THROAT AND EAR,** Medical and Surgical. By William Lincoln Ballenger, M.D., F.A.C.S., and Howard Charles Ballenger, M.D., F.A.C.S. Ed. 6, 1138 pp., 583 engravings, 29 plates, Phila., Lea & Febiger, 1930.

The sixth edition of this work, revised by Howard Charles Ballenger, has become a formidable treatise of over 1100 pages and 600 illustrations. Drs. Tucker and Jackson have written the part on Bronchoscopy, Esophagoscopy and Gastrosocopy. The chapter on the Labyrinth has been rewritten by Dr. Alfred Lewy. Other changes and revisions throughout the book have brought it up to date and it should retain for many years its position as one of the standard works of reference in its field.

**UEBER RÖENTGENSCHAEDEN UND SCHAEDEN DURCH RADIOAKTIVE SUBSTANZEN.** By Priv.-Doz. Dr. Wilhelm Flakamp, Gynecological Clinic, Univ. of Erlangen. 365 pp., 94 illus., 30 half-tone plate illus. and 6 tables. Berlin, Urban und Schwarzenberg, 1930.

Just what we have been looking for! A collection of all the known facts concerning the possible damage resulting from the use of roentgen rays and other radioactive sources. This mine of information will undoubtedly find its way very soon into the library of every member of the legal or medical profession who has an active interest in x-ray damages and the legal action which so often attend them. From the scientific point of view the work is also a rich repository of facts gleaned from the literature of the world. The book is illustrated with numerous photographs, some of them series of pictures of the same case taken during the life of the patient and therefore constituting a document of unusual worth.

The first section deals with a brief historical statement, the various theories relating to the mechanism of damage to the skin from x-ray exposure, and a very detailed study of the biological and histological manifestations of roentgen erythema and dermatitis, treated from every possible point of view. Other high lights are sections on roentgen carcinoma, roentgen ulcer, telangiectasis, and the prophylaxis and treatment of roentgen dermatitis.

The second section concerns damage from x-rays to the deeper tissues and the internal organs, including in turn a consideration of the subcutaneous tissues, muscles, bones and joints, the teeth, serous membranes, the lungs, larynx, intestines, the urinary tract, brain and central nervous system, the eyes, the glandular organs (thyroid, thymus, hypophysis, pan-

creas, liver, etc.). Liberal space is given to the effects upon the generative organs of men and of women, and especially the influence of irradiation upon pregnancy. Final sections are devoted to the blood and the blood-building organs, and general roentgen reactions. Very full lists of references to the literature terminate this very important contribution to the literature of radiation therapy.

DIE RÖNTGEN-LITERATUR Autoren- und Sachregister Patentliteratur. Herausgegeben von Dr. Hermann Gocht. VIII Teil, 1927, 350 pp. IX Teil, 1928, 384 pp. Stuttgart, Ferdinand Enke, 1928, 1929.

The eighth and ninth volumes of Gocht's annual bibliography of radiological literature present a picture of the work done in radiology in 1927 and 1928. The literature of all languages seems to be thoroughly covered. Everyone interested in radiology owes a debt of gratitude to both Dr. Gocht and his publishers for making available annually in a handy volume a bibliography of this increasingly important subject.

A fairly careful check-up reveals few errors or omissions. The book arouses in the reviewer a wish that a similar bibliography could be published on every specialty of medicine. The finding and checking of references would indeed be simplified.

RÖNTGENUNTERSUCHUNGEN AM INNENRELIEF DES VERDAUUNGSKANALS von Dr. Hans Heinrich Berg. Ein Beitrag zur klinischen Roentgendiagnostik Insbesondere Von Entzündung, Geschwür Und Krebs. 193 illus., Leipzig, Georg Thieme, 1930. Price, paper 27 m., bound 29 m.

One of the evolutions which has been taking place in diagnostic radiology concerns the more accurate study of the lining of the alimentary tract. This was first accomplished, as is well known, by opaque materials introduced into the stomach, accomplished in 1897 by Cannon and Williams in Boston and then 1908 popularized by Rieder in Munich. This method

undoubtedly opened up an entirely new field in diagnostic radiology and has resulted in an accuracy of diagnosis exceeding that of all the other laboratory methods combined. There are, however, further refinements which have been achieved by Forsell, Schwarz, Barclay, Akerlund, Baenisch, Chaoul, Milani and Fischer. All of these men have sought to so modify the original opaque-meal technic as to bring out details of the mucous membrane in various segments of the alimentary tract.

The present work relates somewhat briefly the historical development of the method and the apparatus with which the author's studies were carried out. Forsell, Barclay, Akerlund and Schwarz sought to make manual pressure against the anterior abdominal wall to bring out the details of the gastric rugae. Fischer sought to accomplish the same thing by the introduction of air, with the ingestion or injection of just a small amount of contrast material. Baensch, Chaoul and the present author have been leaders in the improved technic of securing mechanical firm pressure against the abdominal wall over the segment of the alimentary tract under study. Holzknacht sought to do this by means of a wooden distinator, with which pressure was made by the hand while the film was being exposed. The later authors have accomplished this pressure by means of a balloon-belt apparatus, which was strapped around the patient. The balloon is then inflated until fluoroscopically it is seen that the proper amount of pressure is being made in the proper place, and then films are exposed. The resulting films reveal an astonishing wealth of detail regarding the mucous lining of the various portions of the alimentary tract, so that the method constitutes a distinctly valuable supplement to the current methods of barium diagnosis. The 193 illustrations in this book comprise a very fine library of reference roentgenograms, valuable to any diagnostician interested in gastroenterology.



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A CLINICAL STUDY OF THE  
ABDOMINAL CAVITY AND PERITONEUM

EDWARD M. LIVINGSTON, M.D.

PUBLISHED SERIALY IN

*The American Journal of Surgery*

SIXTH INSTALLMENT

SECTION I. THE CAVITY (CONTINUED)

SECTION II. THE GASTROINTESTINAL TRACT

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# A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM

## SECTION I. THE CAVITY

### F. PRESSURE VARIATIONS WITHIN THE ABDOMEN (*Continued*)\*

5. EFFECTS OF INTRA-ABDOMINAL FAT. Aside from the viscera with the liquids and gases they contain the chief content of the abdominal cavity is fat. Intra-abdominal fat, stored within mesenteries, ligaments and extraperitoneal spaces, acts as padding and serves to strengthen natural supports. Changes in the amount of this fat, as any change in the contents of the cavity, must be compensated for in some way. It has been shown, both clinically and experimentally, that when there is a marked loss of intra-abdominal fat, there follows a compensatory atonic dilatation of hollow viscera, particularly of intestines.<sup>92</sup> Digestive and asthenic symptoms following an illness attended by a marked loss of weight may be accounted for in many instances by the loss of intra-abdominal fat and the secondary changes attendant upon this loss. The restoration of fat, because it strengthens mesenteric supports and causes a return of dilated gut to normal, is an important post-operative measure.

A large umbilical or incisional hernia which has existed for a long time in a fat individual contains, in addition to other structures a deposit of fat. The amount of this fat tends to be in direct proportion to the size of the hernia. This overproduction of tissue may be so great as to make it difficult if not impossible to return all of the herniated mass to the abdominal cavity. Many complications may be avoided by securing in such patients a decided reduction in weight during

Preoperative Reduction in Weight with Large Ventral Hernias

\*Previous installments of this book appeared as follows: January issue, p. 193; February issue, p. 459; March issue, p. 693; April issue, p. 92; May issue, p. 1110.

an extended period of preoperative treatment. It has been said that if a weight reduction of 20 or more pounds can be obtained in patients having large ventral hernias, there will be little difficulty in securing complete reduction of the mass, and that postoperative complications will be appreciably less.<sup>115</sup> The high mortality following operation for large ventral hernias may be explained, at least in part, by the overcrowding of the cavity after abdominal closure.

6. EFFECTS OF GRAVITY. Gravity is most important among the factors which determine pressure variations within the abdomen. In the upright position the movable organs, generally speaking are approximately 3 cm. lower than in the prone position.<sup>116</sup> The organs lie in actual contact with one another, the upper being partially supported, as on a cushion, by the organs below. On account of the specific gravity of the viscera, the static pressure in the most dependent portions of the abdomen is considerable. The Fowler, knee-chest, and Trendelenburg positions and the elevation of the foot of the bed all illustrate common uses of gravity to alter intra-abdominal conditions.

An effect of gravity is noted in the spontaneous reduction of a hernia when the patient assumes a recumbent posture. The patient using a truss learns that it is of advantage to keep this device near the bed and to apply the truss before arising in the morning thereby being sure of a complete reduction and retention of the hernia. The visceroptotic patient may have learned the same regarding the application of his belt.

#### The Knee-Chest Position

That a change of posture results in a change in static pressures explains the condition known as "garrulitas vulvae." When the female patient assumes the knee-chest position, pressure is removed from the vaginal vaults as the movable organs of the pelvis and lower abdomen gravitate toward the diaphragm; and when the labia are separated air is admitted to the vagina; when the upright position is resumed a noisy expulsion of air takes place as the static pressure is restored in

the lower abdomen and the vaginal capacity is again reduced. Opening the vulva to admit air is an important, though frequently neglected part of the knee-chest exercise (see eponym:

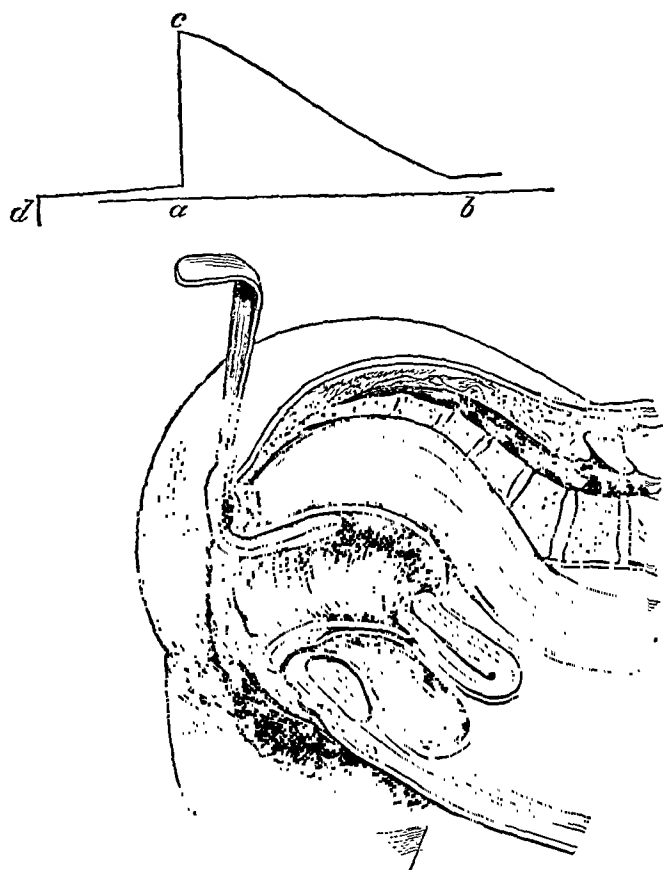


FIG. 85. The knee-chest posture. Note distention of vagina with air as labia are separated.  
(From Sims.)

Marion Sims);<sup>117</sup> so also is the taking of deep inspirations while in this position (combining the upward pull of gravity in the reverse static position with the upward pull or suction caused by subdiaphragmatic negativity). A woman assuming the knee-chest position may derive certain benefits therefrom, but will probably gain more through admitting air to the vagina and still more when adding deep breathing to the exercise (Fig. 85).

The relationship between local static pressures and general intra-abdominal pressures may be illustrated as follows: the

fundus of the uterus may rest forward upon the bladder or backward upon the rectum, causing in one instance bladder, and in the other, rectal-pressure; yet obviously the position of the uterus can have little bearing upon any pressure which may be present within the abdomen as a whole.

The Habitus  
Enteropticus

7. EFFECTS OF INDIVIDUAL HABITUS. The habitus of the individual, particularly with regard to the shape of the lower thorax, and the erectness of the spine (a narrow chest and a forward curvature of the spine serving to diminish abdominal capacity) plays an important rôle in determining the character and distribution of abdominal pressures. Individuals with narrow, flat chests and sharp intercostal angles (habitus enteropticus) exhibit markedly different intra-abdominal arrangements from those of the square-chested type. Patients with congenital visceroptosis display a constitutional weakness in supporting tissue.<sup>118</sup> This is noted by the malposition of one or many organs, the partial or complete failure of normal embryonic rotations and fusions in the gastrointestinal canal and the continuous display of subjective abdominal symptoms of a distressing nature. There seems also to be an excessive tendency to the formation of intraperitoneal adhesions. The small capacity of the upper abdomen crowds the viscera to abnormally low levels and produces lengthening and traction upon intra-abdominal supports, thus markedly accentuating such symptoms as are caused by any downward displacement of the organs. The abdomen presents an s shape, being flat or retracted above and protuberant below (Fig. 86).

Subjective Sym-  
ptoms from Vis-  
ceroptosis

Subjective symptoms are due chiefly to stretching and irritation of the splanchnic nerves and vagi together with torsions and pressures upon local blood vessels. These range from the dull gnawing feeling within the epigastrium and the slight faintness or giddiness experienced after going for a long period without food, to the severe grades of gastrointestinal, cardiovascular, pulmonary, nervous and nutritional disturbances, noted with marked visceroptosis, constituting the sympathetic imbalance of a true Glenard's disease.<sup>118</sup>

Visceroptosis represents one of the most important of surgical studies. Though common, this condition all too frequently remains unrecognized and the patient may pass through many



FIG. 86. Contour of the abdomen with marked visceroptosis. (From French.)

hands, both medical and surgical, before recognition is taken of the stigmata present. Patients having the acquired form of visceroptosis complain chiefly of gastrointestinal symptoms while those with the congenital type of this condition are, as a rule, classed as neurasthenics. The symptoms, which are most varied, may simulate several abdominal diseases and lead to operative intervention which usually proves disappointing as to end-results.<sup>120</sup> A report has been given concerning 1000 such patients, averaging two and one-half operations each, but presenting a chain of baffling symptoms and syndromes which were little influenced, unless exaggerated by operation. It is not implied that with visceroptosis operations are always contraindicated but they should certainly be undertaken only after due deliberation, and the results should be interpreted in terms of the developmental stigmata which underlie the condition.

Methods for  
Visceral Elevation

The subjective symptoms due to displacement of viscera are, as a rule, promptly relieved by support, if this adequately replaces the viscera. Relief is less certain with the congenital than with the acquired type of visceroptosis, because in the former, the shape of thorax and abdomen makes complete replacement difficult or impossible, and the nervous symptom-complex is of such long standing as to be more or less fixed in degree. Measures aimed at a replacement of the organs include<sup>118-120</sup> sleeping with elevation of the foot of the bed; regular assumption of the knee-chest, Trendelenburg, or some other reverse-static posture; prolonged rest in bed with the administration of a fattening diet calculated to shorten ligamentous and mesenteric supports; the use of mechanical binders and straps; the employment of special athletic exercises; and occasionally, operative shortening or rearrangement of abdominal supports. The extent and type of treatment naturally will vary with the severity of symptoms. Treatment, of whatever type, tends to prove quite ineffective unless the viscera are actually elevated and are so supported as to remove downward traction; but when this is efficiently accomplished, prompt relief may be anticipated. The natural support given the organs by the pregnant uterus often grants the visceroptotic woman a period of relief from symptoms and demonstrates the value of adequate elevation and visceral replacement.

RECAPITULATION CONCERNING INTRA-ABDOMINAL PRESSURES. Pressure changes within the abdomen are complex. To assume a close analogy as to pressure conditions between abdomen and thorax must lead to errors. The thorax has a special anatomical composition (rigid walls) to allow for a special physiological activity (respiration) which is entirely dependent upon a reasonably constant relationship between the pressure within and that of the atmosphere. Intrapleural pressure is little effected by gravity, by variations in fat content or size of viscera, or by many other factors which have been seen to play so important a rôle in determining pressures

within the peritoneal cavity. Neither abdominal structure nor abdominal function implies a uniform pressure throughout the peritoneal cavity nor any constant pressure range within this potential space.

The meaning of the term intra-abdominal pressure is necessarily somewhat vague. It is not incorrect to refer to increased intra-abdominal pressure where, by a sudden contraction of the muscular walls, any previously existing pressures are grossly increased; or again, where there is a bulging of the walls from some obvious, generalized and considerable elevation of pressure. An analogous generalized and marked pressure-decrease may be spoken of as a reduction in intra-abdominal pressure. But it must be borne in mind that pressure conditions within the abdomen are a combination of intraperitoneal pressures, static pressures, and intravisceral pressures; and that changes and adjustments are continually being made.

Basically the mean intra-abdominal pressure tends to be equal to that of the atmosphere, for the abdomen, a non-rigid sac, is directly subject to atmospheric pressure and its walls tend passively to bulge outward when the pressure within exceeds that of the atmosphere (ascites; paralytic ileus) or to passively move inward when the pressure within is below that of the atmosphere (dehydration; cachexia). But the abdomen is a muscular sac capable, by voluntary contraction of its walls, of suddenly increasing any pressure within (cough) and by continued involuntary contraction (reflex rigidity) of maintaining such increased pressure; the muscles also, through vital reflex phenomena, may relax and thus decrease intra-abdominal pressures (abdominoenteric reflex). Because of the location of the abdomen, separated from the pleural cavities only by a thin musculofibrous membrane, the upper portions of the peritoneal cavity display a slight reflected negativity (subatmospheric pressure or tension phenomenon) showing the presence of an upward pulling force. Because of location, also, the intra-abdominal pressures show variations



with the phases of the respiratory cycle; and these, in turn, are influenced by the habitus of the individual and his type of breathing, the relative negativity in the upper peritoneal cavity being greatest when breathing is of the thoracic type and during the inspiratory phase of the respiratory cycle, and least when breathing is of the abdominal type. Abdominal pressures, again, vary continuously with changes in intra-visceral pressures (those within individual organs). Any change in pressure within one organ is, of necessity, compensated for by changes in other abdominal viscera or in the abdominal walls. Gravity also is a most important controlling factor in determining pressure variations within the abdomen.

When the surgeon means specifically to refer to intra-visceral or intraperitoneal pressures, or to those due to gravity (static pressures) he should, when possible, so state. The success of diagnostic methods and therapeutic measures which are in any way dependent upon pressure variations within the abdomen will tend to bear a direct relationship to the accuracy with which the true causes of the pressure variations are interpreted.

## SECTION II

### THE GASTROINTESTINAL TRACT

THE abdomen has thus far been considered simply as an empty space. It has first been investigated as a cavity devoid of viscera and emphasis has been placed upon the interrelationships between the abdomen and other parts of the body. That perspective has been sought which would ensure the truest understanding of the cavity as a whole. And now, by a closer approach, attention will be directed to the abdominal contents and intra-abdominal organs will be individually studied.

As attention is thus withdrawn from the abdominal walls interest at once centers upon the gastrointestinal tract. The enteric canal with its voluminous intestinal loops and massive glandular outgrowths practically fills the abdomen (Fig. 87). It has a length equal to from five to six times that of the body itself. Alike by fact and by derivation of terms the intestines constitute the "inwards" or the "insides" of the belly (L. *intus*, within) (entrails, L. *interaneus*, internal, inward, interior). As is readily apparent the space within the abdomen is given over almost entirely to processes of alimentation (L. *alimentum*, food, nourishment). This extreme length of the alimentary canal represents an adaptation to function. Digestion (L. *digerere*, to dissolve or divide) is in part chemical and in part mechanical and this necessitates the provision of a large lymphatic and vascular absorptive area and of adequate storage space both for foods and waste products. Occupying the major portion of the abdominal cavity the gastrointestinal tract becomes a major consideration in any review of this space.

It seems quite generally agreed that there is but one logical point at which to begin a broad investigation of this tract, namely with a study of its origin. Embryology has proved the most reliable guide in explaining adult conditions.

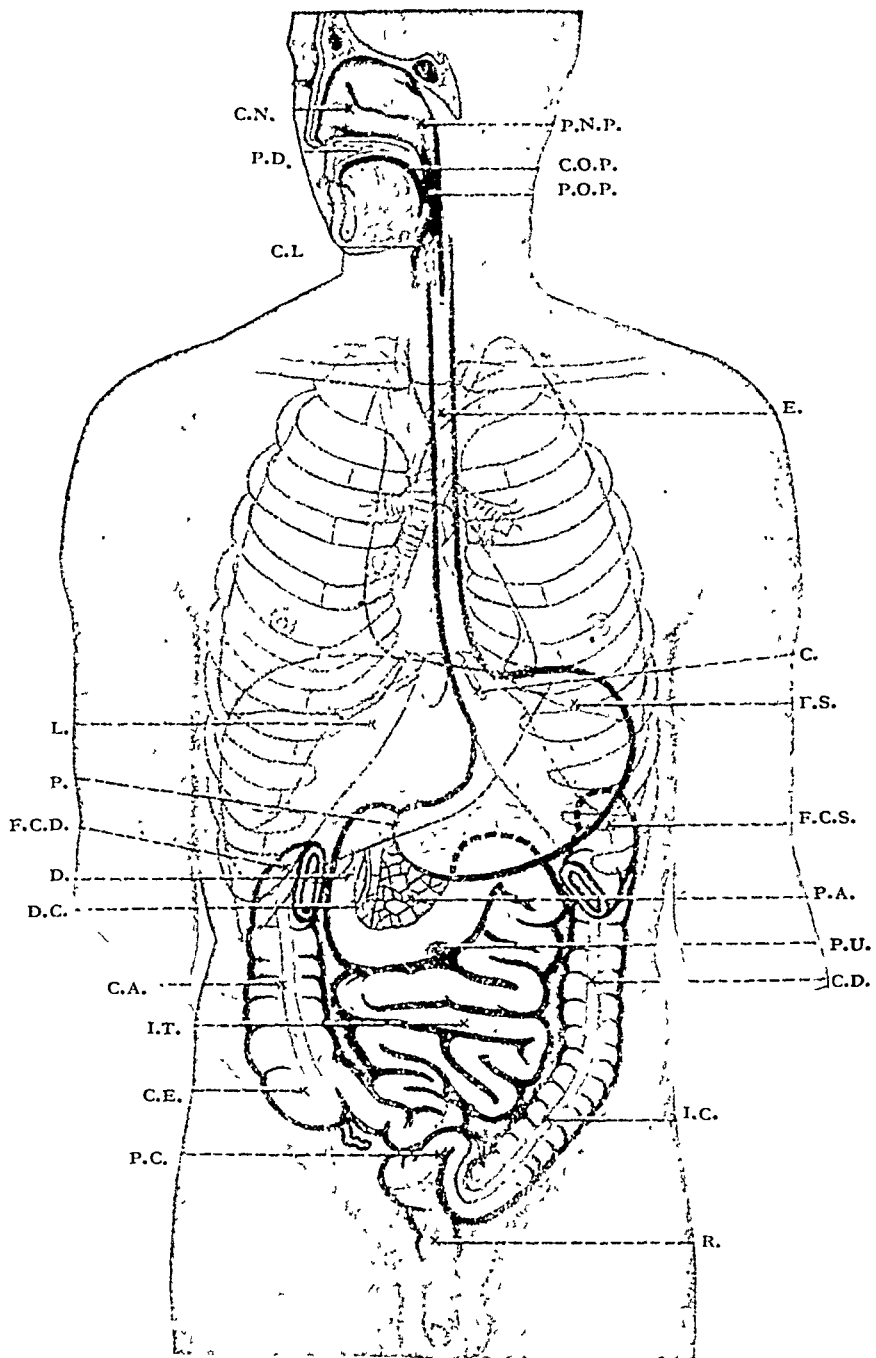


FIG. 87. Note that the enteric canal with its voluminous intestinal coils and massive glandular outgrowths practically fills the abdomen. (From Cunningham.)

C.N., Cavum nasi. P.N.P., Pars nasalis pharyngis. P.D., Palatum durum. C.O.P., Cavum oris proprium. P.O.P., Pars oralis pharyngis. C.L., Cavum laryngis. E., Esophagus. C., Cardia. F.S., Fundus of stomach. L., Liver. P., Pylorus. F.C.S., Flexura coli sinistra. F.C.D., Flexura coli dextra. D., Duodenum. D.C., Ductus choledochus. P. A., Pancreas. P.U., Position of umbilicus. C.A., Colon ascendens. C.D., Colon descendens. I.T., Intestinum tenue. C.E., Cecum. I.C., Iliac colon. P.C., Pelvic colon. R., Rectum.

Anatomical and physiological considerations which might otherwise remain almost inexplicable are rendered relatively simple through a study of the development of the digestive tube. Many observations made at the bedside and many manouvers suggested for the surgical amphitheater are rendered clearly intelligible only through insight into the series of changes which take place during embryonic life.

In the present post-graduate review, therefore, no short-cut will be attempted from this somewhat laborious method of tracing step by step succeeding developmental alterations, for the inevitable reward is a more clear understanding of both diagnostic and operative matters. A clinical review, it might be pointed out, has as its immediate aim only the study of points which are essentially practical. But to fully appreciate bedside observations some fairly accurate knowledge must first be had of the mechanism by which signs and symptoms are initiated. Correct diagnostic conclusions are necessarily dependent upon a correct interpretation of the diagnostic data. In succeeding pages, then, there will be combined and correlated in the most intimate fashion topics which are elemental and basic with those which are purely clinical in character and the attempt will be made, not only to discuss the clinical observations themselves, but in addition to take up the manner in which they may be produced and to suggest ways in which they may be accounted for.

#### A. BASIC EMBRYOLOGICAL CONSIDERATIONS

The abdominal portion of the body consists fundamentally of a tube suspended within a tube (Fig. 88). The outer of these is the abdominal wall, the inner the gastrointestinal tract. The external surface of the body is derived from ectoderm and is protective and "relational" in function, while the innermost surface (i.e., the inner lining of the inner tube, which in actual square surface more than equals the area of the skin itself) is derived from endoderm and represents the nutritional tissue of the body. Between these tubes is that

potential space, its walls derived from mesoderm, which is variously known as the abdominal portion of the body cavity, the adult celomic cavity, the extravisceral cavity,

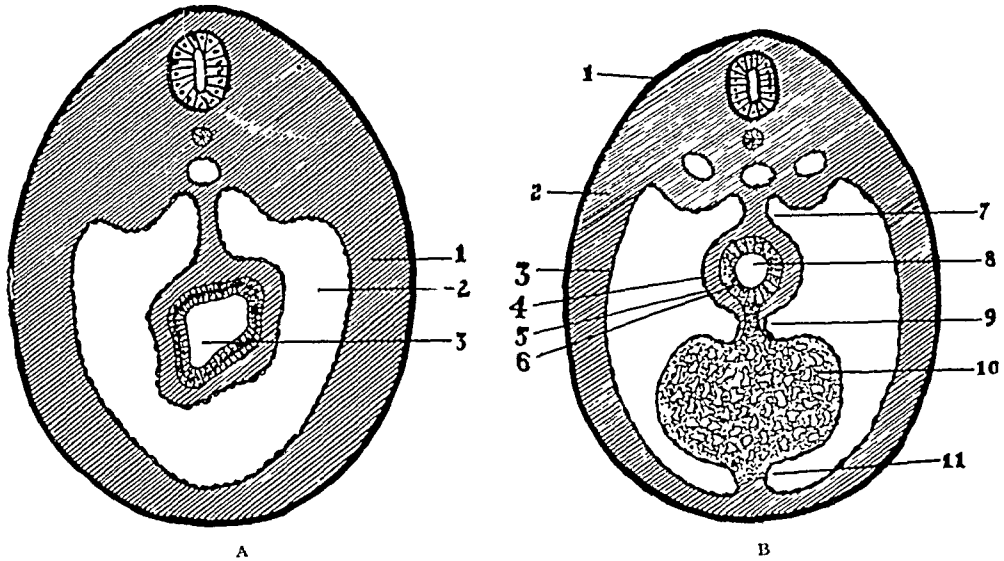


FIG. 88.

A. The abdominal portion of the body consists fundamentally of a tube suspended within a tube; between these tubes lies the peritoneal cavity.

1. Outer tube or body wall. 2. Peritoneal cavity. 3. Inner tube or bowel.

B. An earlier stage of development (cross section above level of umbilicus).

1. Ectoderm. 2. Somatic mesoderm. 3. Endothelial lining of peritoneal cavity (parietal peritoneum). 4. Visceral peritoneum. 5. Splanchnic mesoderm. 6. Endodermal lining of bowel. 7. Primitive dorsal mesentery. 8. Lumen of bowel. 9. Primitive ventral mesentery. 10. Liver. 11. Future falciform ligament of liver.

or the peritoneal cavity. The study of these arrangements and of the clinical significance of the three primary germ layers, involves a consideration of four topics:

1. Origin of the gastrointestinal tract.
2. Origin of the peritoneal cavity.
3. Distribution of the adult gastrointestinal tract.
4. Final attachments of the gastrointestinal tract.

In reviewing the peculiar manner in which viscera and body walls are connected, the operating surgeon is chiefly interested in vascular and peritoneal or membranous connections; while for the surgical diagnostician the dominant interest is in nerve connections.

I. ORIGIN OF THE GASTROINTESTINAL TRACT. It will be recalled that the enteric canal (inner lining of the gastrointestinal tract) develops from the yolk sac.<sup>121</sup> It is formed from this structure as the embryonic streak or rudiment bends forward at its cephalic and caudal extremities while creating the anterior abdominal wall (Fig. 89 B). At first the enteric canal is blind at its cephalic and caudal ends while the middle part of its ventral wall is continuous with the wall of the yolk sac (endodermal lining) into which the archenteron (G. first or primitive intestine) is open for about one-third of its length (Fig. 89 C). The portion of the tract thus open into the yolk sac is termed the midgut; that cephalad to this opening, the foregut; and that caudad, the hindgut. The opening into the yolk sac gradually narrows as the anterior abdominal walls close in, but the archenteron retains a connection with the diminishing yolk sac (now a mere yolk vesicle) by a slender tube of smaller and smaller caliber, the yolk stalk, or vitello-intestinal duct (vitelline, L. yolk) (Fig. 89 D). With the degeneration of the yolk sac into a yolk vesicle this vitello-intestinal duct exerts a traction upon the intestine at its point of attachment and thus draws a loop of small bowel out of the body cavity into the umbilical cord. This intestinal loop, with the duct at its apex, consists of two limbs (Fig. 89 E). The first of these has been variously termed the proximal, descending, leaving or efferent limb; the second is known as the distal, ascending, returning or afferent limb. This protrusion of bowel into umbilical cord is known as the "embryonal umbilical herniation." The loop begins to enter the cord in the 10 mm. embryo (three weeks) and the degree of herniation increases until the tenth week of intrauterine life. Normally after this period the bowel returns to the abdomen (explained below). The umbilicus is the last point in the abdominal walls to close and the navel or omphalos represents the central point of the anterior body wall (navel, L. center; *omphalos*, G. a central object). In the adult the only trace of the early connection between intestinal canal and

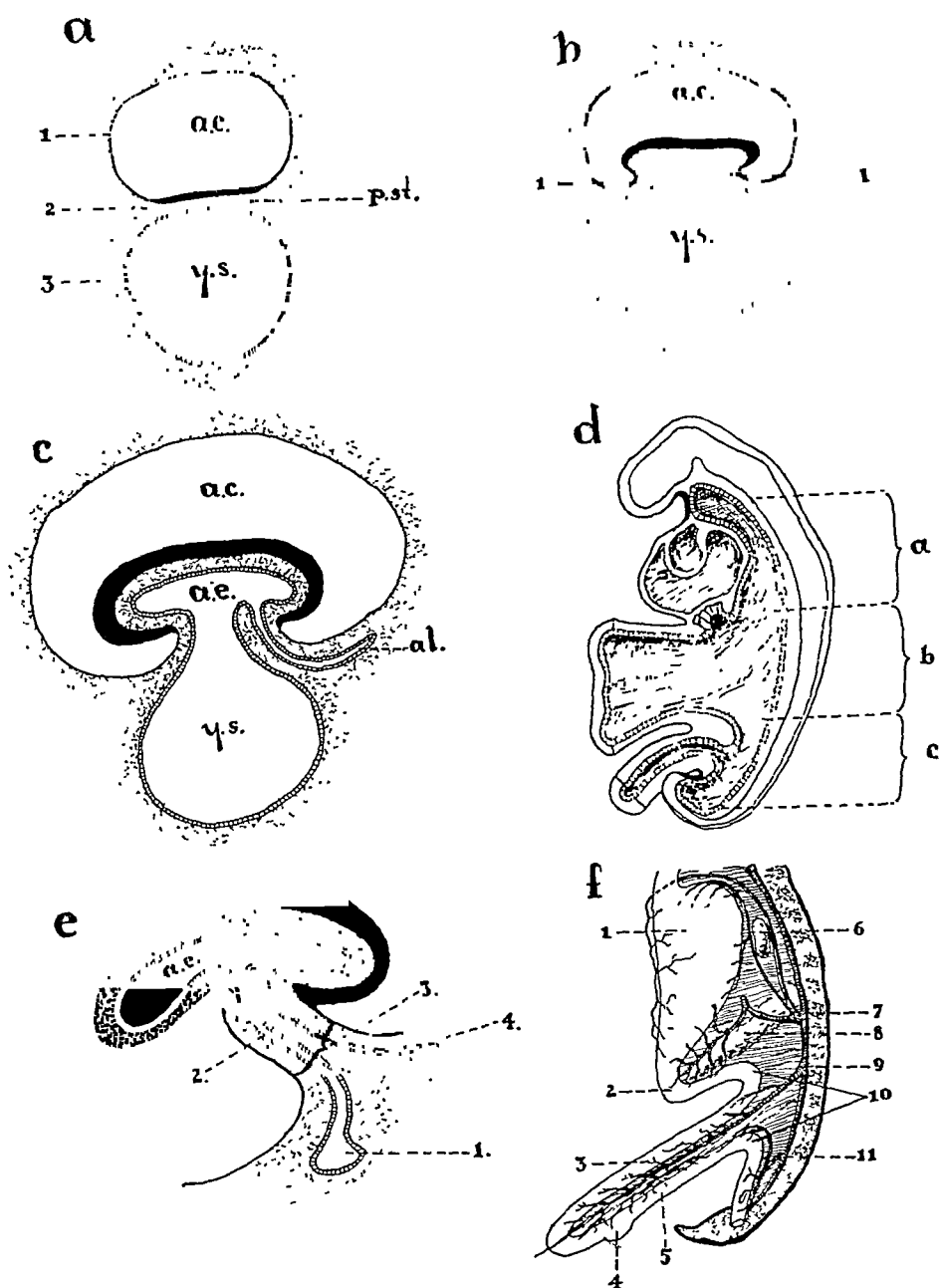


FIG. 89. Formation of gastrointestinal tract.

A. The earliest embryonic rudiment or primitive streak (p. st.), which lies between the amnion (a.c.) and the vitelline cavity or yolk sac (y.s.).

1. Ectoderm. 2. Mesoderm. 3. Endoderm.

B. As the embryo bends forward at its cephalic (1') and caudal extremities (1) the yolk sac becomes constricted and the first evidence of an alimentary canal (embryonic endoderm) appears.

umbilicus is the rare (2 per cent) persistence of a diverticulum or rudiment of a diverticulum, uniting the lower portion of the ileum with the navel (Meckel's diverticulum occurs more or less distinctly in one person in fifty). The visualization of the origin of the enteric canal is aided through the use of accompanying figures.

This brief statement of developmental facts concerns matters which have considerable practical significance. Mention has previously been made of such clinical points as the occurrence of fistulae, cysts and endodermal neoplasms at the navel, the explanation of which depends upon an understanding of the origin of the enteric canal; the persistence at birth within the umbilical cord of a loop of bowel, necessitating care to strip the cord backward to the body wall between the thumb and forefingers before applying clamps or ligatures, has been taken up; the incidence of congenital umbilical hernias has been mentioned, together with the fact that their spontaneous cure within the first two years of life is the rule, due to the inward traction of the umbilical ligaments (obliterated urachus; obliterated hypogastric arteries).

Abnormalities at  
the Navel

Diverticula due to the complete or partial persistence of the omphaloenteric or vitelline duct vary widely as to their point of origin from bowel, their site of attachment within the peritoneal cavity, and as to size and shape. It is very often stated that a Meckel's diverticulum, if present, will be found "within 12 to 14 inches of the ileocecal valve,"<sup>122,123</sup> but the point of origin as a rule is at a considerably greater distance

Congenital Diver-  
ticula of Ileum

*Continued from p. 244.*

c. The alimentary endodermal tube further constricted from the yolk sac.

a.e., Alimentary endoderm. y.s., Yolk sac. al., Allantois. a.c., Amnionic cavity.

d. The alimentary tract remains open in its mid-third into the diminishing yolk sac.

a. Foregut (blind tube). b. Midgut (open anteriorly). c. Hindgut (blind tube).

e. Alimentary canal, a closed tube except for its communication with the yolk vesicle through the vitello-enteric duct and into the allantois.

a.e. Alimentary canal (endoderm). 1. Yolk vesicle. 2. Vitello-enteric. duct. 3. Umbilical cord. 4. Allantois.

f. The primary loop of the gastrointestinal tract.

1. Stomach. 2. Duodenum. 3. Descending limb of intestinal loop. 4. Cecal bud. 5. Ascending limb of loop. 6. Spleen. 7. Celiac axis. 8. Pancreas. 9. Superior mesenteric artery. 10. Duodenocolic isthmus or base of loop. 11. Inferior mesenteric artery.



from the large bowel. Meckel himself simply gave the place of origin as "in the small intestine and nearer its lower than its upper extremity"<sup>124</sup>; he stated that it "varies to a considerable extent." Huntington found by actual measurement in 22 instances of this anomaly that the average point of attachment to bowel was located 107 cm. or 3 ft. 6 in. from the ileocecal valve.<sup>125</sup> The obvious practical significance of this fact is that when operating for intestinal obstruction of unknown cause, search for a congenital diverticulum of the ileum as a possible cause, should extend over a wider area than the terminal  $1\frac{1}{2}$  feet of ileum. At least the terminal  $3\frac{1}{2}$  feet of ileum must be examined to discover the average case and the presence of a diverticulum cannot be positively ruled out unless over 9 ft. of terminal ileum are inspected.

A Description of  
the Diverticulum  
of Meckel

A Meckel's diverticulum is always single. The diverticulum arises from the free margin of bowel (at a point opposite to the mesenteric attachment) and usually passes away from the ileum at a complete or right angle (Fig. 90 A). This congenital anomaly contains all of the coats of the bowel wall, a circumstance which serves to distinguish it from false or acquired diverticula. The diverticulum at its point of origin may have a caliber equal to that of the ileum itself, or it may be smaller, even being a cord with the finest of central apertures (Fig. 90 B). A Meckel's process is always broader at its point of origin than at any other point. It frequently tapers rapidly as it leaves the ileum, although the extreme tip may be somewhat clubbed or bulbous, due to a herniation of the mucus through the muscular coat (Fig. 90 C). At times the diverticulum is a mere pouch or nipple-like process in the lower portion of the ileum. The diverticulum may extend directly to the umbilicus, usually as a cord but rarely as an open duct; it may attach internally to the midline at a varying distance from the umbilicus; at times its extremity is attached to intra-abdominal structures, notably the mesentery of the bowel or the bowel wall (Fig. 90 D); in still other instances, and quite commonly the terminal extremity of the diverticulum

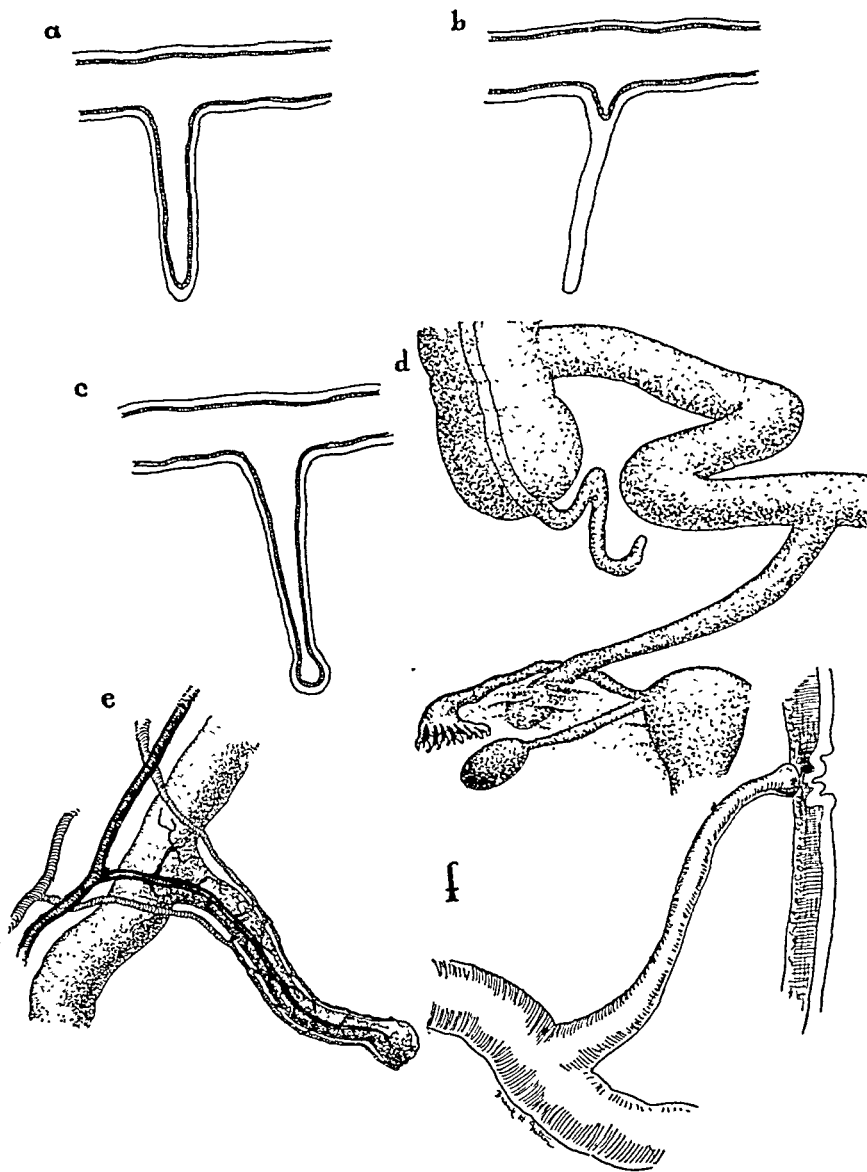


FIG. 90. Varieties of Meckel's diverticulum.

A. Diverticulum leaves bowel at free border (opposite mesenteric attachment) at right angles to long axis of bowel.

B. At times the process is little more than a fibrous cord.

C. The diverticulum is always largest at its point of origin from bowel, but sometimes has a bulbous tip.

D. Tip of diverticulum has acquired a secondary attachment (in this case to broad ligament).

E. Showing vessels (these are called vitello-mesenteric vessels) which may accompany the diverticulum. Note how the vessels pass over and may constrict bowel wall.

F. Diverticulum passing to umbilicus; small endodermal cyst at anterior abdominal wall.

lies free and unattached within the peritoneal cavity, the process having an average length of 3 inches.

Persistent Omphalo-mesenteric Vessels

Vessels may accompany the diverticle, whatever its course. These may consist of an artery and two veins.<sup>124</sup> They arise from branches of the superior mesenteric vessels, cross over the ileum opposite their points of origin, and traverse the walls of the congenital pouch (Fig. 90 E). These vessels may themselves constrict the bowel. They originally had the function of nourishing the yolk sac and are therefore called the omphalo-mesenteric vessels. In the rarest of instances the arteries or fibrous cords representing them may pass from their mesenteric origin to the region of the umbilicus even when there is no congenital diverticulum of the bowel.

Comparison of True with False Diverticula of the Ileum

In contrast to the diverticulum above described, acquired or false diverticula of the ileum are almost without exception multiple.<sup>126</sup> They arise along the attachment of the mesentery to bowel wall, not at the free bowel border (Fig. 91). They are short; they are polypoid or clubbed, and at their point of origin are narrower than at other parts. Although subject to secondary inflammation they do not cause mechanical obstruction of bowel. They occur in old people, rarely in the young. These multiple acquired outgrowths are caused by protrusion or herniation of mucous lining through the muscle coat; they never, as does a Meckel's diverticulum, contain a covering of muscle. False diverticula, then, differ from a Meckel's process in all essential points, in structure, number, shape, position, size, age incidence and potentialities:

The omphaloenteric duct or persistent omphalo-mesenteric vessels give rise to intestinal obstruction in 4 ways: (1) by bowel strangulation under a fibrous cord or diverticulum; (2) by loops or nooses of the diverticulum or a cord; (3) by those remarkable formations known as diverticular knots, and (4) by the passage of the diverticulum into a hernial sac (Fig. 92).

The first method is by far the most common (outnumbers the other causes by over three to one). Obstruction rarely occurs when the attachment of the diverticulum is to the



FIG. 91. Differentiating a congenital diverticulum (Meckel's) from acquired or false diverticula. The former is single, contains all coats of bowel, arises at free border of bowel, has its largest caliber at its point of origin and is 3 inches in length. The false diverticula are multiple, short, pedunculated, contain no muscular coats, and arise along the attachment of the mesentery to bowel, not opposite to free bowel margin. (From 3rd Surg. Div., Bellevue Hosp.)

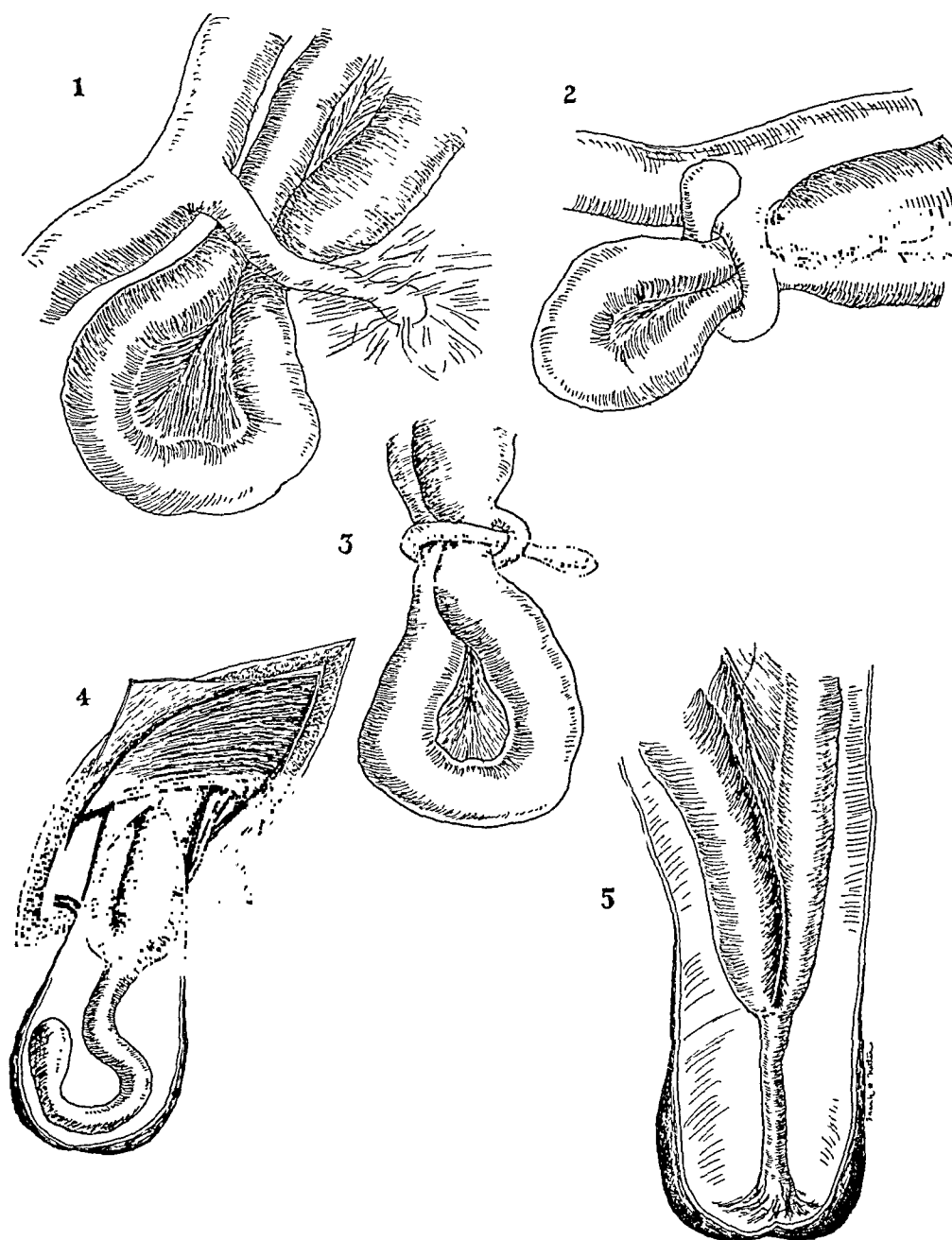


FIG. 92. Intestinal obstruction from congenital diverticula (Meckel's).  
 1. Obstruction beneath diverticular band. 2. Obstruction by a diverticular noose. 3. Obstruction by a diverticular knot. 4. Obstruction of diverticulum within a hernial sac. 5. Obstruction from angulation of ileal loop by diverticular traction.

umbilical region, but commonly occurs when there is a secondary attachment to mesentery or bowel. These points of secondary attachment are often determined by intraperitoneal inflammations and have been reported at the site of old inguinal hernias, sclerotic mesenteric glands, or to inflammations about ovaries, tubes or appendices. When the diverticulum is short only a small knuckle of bowel is capable of engaging beneath the resultant loop, but when the loop is long a large portion of bowel may become either incarcerated or strangulated. The diverticulum sometimes forms a loop or a compound loop into which bowel becomes engaged and subsequently ensnared as a later change occurs in the lines of traction within the belly. Intestinal obstruction from knots is explained graphically in accompanying figures. A bulbous enlargement of the tip of the diverticulum, as previously referred to, plays an important rôle in the formation of these peculiar knots, for once the knob-like process has become engaged through an aperture it does not again readily become disengaged.

Varieties of Intestinal Obstruction from Persistent Omphalo-enteric Ducts

The study of embryology aids not only in an understanding of diverticula but also in the interpretation of symptoms produced by gastrointestinal disorders. It proves particularly valuable in explaining the localization of pains due to alimentary tract affections. The six-weeks' embryo with its primary loop of bowel and its simple distribution to this loop of vessels and nerves, furnishes a picture which makes readily intelligible the distribution of such pains to the midline of the anterior abdominal wall. To determine the exact sites to which the patient refers his pains is a matter of the utmost importance in the diagnosis of surgical disorders within digestive organs. As early as 1892 MacKenzie published results of a careful inquiry into this pain-reference as described by 320 patients suffering from affections of stomach.<sup>127</sup> He found the pain in 95 per cent of cases to be localized within the epigastrium. Subsequently, after keeping records of several thousands of cases, he reached the conclusion that the patient does not

Site of Pain From Gastro-intestinal Affections

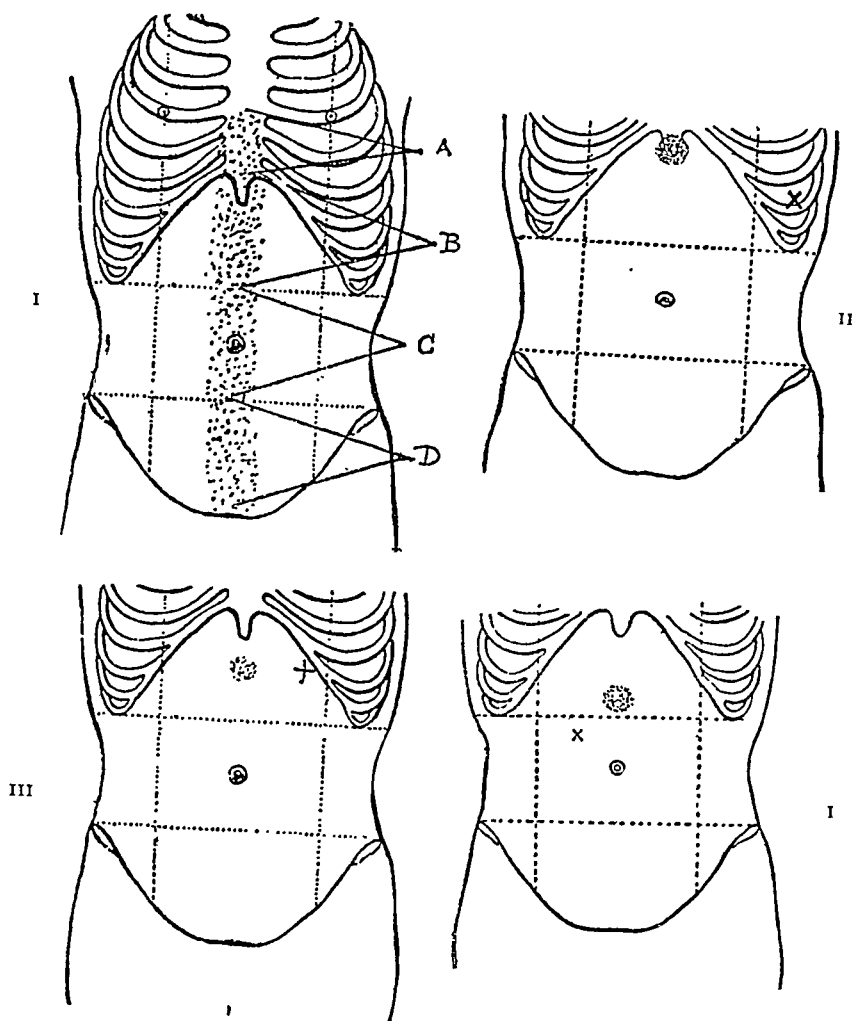


FIG. 93. I. The shaded parts show the areas in which pain is felt in affections of the digestive tube. (From Mackenzie.)

A. Area in which pain is felt in affections of the esophagus. B. Area in which pain is felt in affections of the stomach. C. Area in which pain is felt in affections of the small intestine. D. Area in which pain is felt in affections of the large intestine.

II. The shaded area shows site of pain, x corresponds to the position of the ulcer in the stomach as found at the post-mortem examination.

III. The shaded area shows the site of pain, and the position of the gastric ulcer as found at operation.

IV. The shaded area shows the site of pain, x the site occupied by the ulcer at the pyloric orifice of the stomach as found at the post-mortem examination.

actually feel pain within the viscera themselves but refers it to the abdominal walls and to the area of distribution of sensory nerves of the cerebrospinal system. And according to the observations of Mackenzie the pain from digestive disturbances is interpreted by the patient as arising at the periphery of this sensory nerve distribution, that is, approximately at the midline of the body anteriorly. He stated "from the top of the oesophagus to the anus there is, in the vast majority of cases, a limitation of the distribution of the pain to an area extending down the centre of the body from the middle of the sternum to the symphysis pubes."<sup>127</sup> (Fig. 93.) Thus, when the inner lining of the oesophagus is irritated by a too hot drink, pain is always referred to a region over the lower part of the sternum; organic lesions of stomach, whether located near cardia or pylorus, give rise to pain which is referred to the epigastrium; such conditions of small bowel as strangulation of an intestinal loop yield pain which is felt in the neighborhood of the umbilicus; and again, affections of large bowel (volvulus of sigmoid, diverticulitis, stricture) when these cause pain, cause it within the hypogastrium.

There are several ways of demonstrating that the pain is not actually felt "within" esophagus, stomach, or bowel or "inside of the belly" as the patient may himself believe and state. The following facts well illustrate the reference of the pain to the tissues of the body walls; gastric pain is epigastric in location although the stomach itself may lie at a lower level or even extend into the hypogastrium or pelvis and the epigastric pain remains constant in location although the stomach is known to shift about during periods of functional activity. Again, while the intestinal loops twist and coil throughout the entire infracolic division of the abdominal cavity and are quite largely hypogastric and pelvic in location, small bowel pain without accompanying peritonitis is referred with uniformity to the area about the umbilicus.

Mackenzie's original illustration of the areas in which pain is felt in affections of the digestive tube is reproduced in

Pain Reference to  
the Periphery



The Three Equi-  
distant Pain Zones  
of the Midline

Figure 93. Considering the anatomical distribution of the various components of the gastrointestinal tract, the nature of this reference of pain to the midline of the body is astonish-

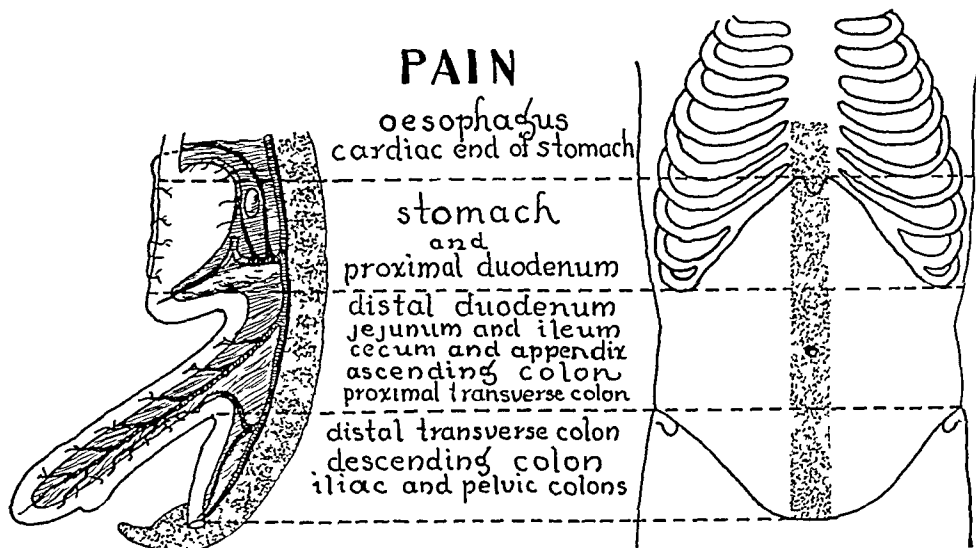


FIG. 94. Study of reference of gastrointestinal tract pains to three equidistant zones in midline of anterior abdominal wall.

ing. Why does it occur that affections of stomach and duodenum give rise to pain which is felt over some 6 in. of the midline while affections of small intestine, within any part of its many feet of tortuous course, have a body-wall zone of no greater size (the 5 or 6 in. about the umbilicus)? What accounts for this inequality of length between the areas of pain-reference and of the bowel divisions themselves? Why is it, also, that large bowel pain is situated at a lower point than small bowel pain, when anatomically the colon describes a loop about the periphery of the abdomen and has right and left flexures which reach to the hypochondriac regions, while the terminal ileum is situated at such a low point in the abdomen or even within pelvis? It is when the adult surface map for pain is juxtaposed to a picture of the six-weeks' embryo that the situation becomes easily clarified (Fig. 94). It may be noted that the upper third of the abdominal portion of the archenteron gives rise to the stomach and proximal duodenum;

that the mid-third gives rise to terminal duodenum, all remaining parts of small intestine, to cecum, appendix, ascending colon, and to the proximal portion of the transverse colon; that the distal third of the primitive bowel gives rise to the remainder of the colon. Since the nerve tissue is being distributed at this period of development (see invasion of ectodermal tissue into the abdominal cavity) and since the central nervous connections are established at this time, it follows that all subsequent twists, elongations or other changes occurring in individual portions of the tract have but little effect upon adult reflex pathways. The relationships of the three primary divisions of the archenteron to the three equi-distant zones of the midline of the anterior abdominal wall remain fixed and constant.

But while stomach disorders produce, with great regularity, pain which is epigastric in situation, it by no means follows that epigastric distress always signifies some gastric lesion. The stomach has been referred to as "the spokesman of the abdomen"<sup>128</sup> and roughly only about one-third of stomach symptoms are due to actual gastric lesions. Another third are caused by extragastric diseases existing within the abdomen or pelvis, as for example cholelithiasis, chronic appendicitis, tuberculous peritonitis, ovarian cyst, salpingitis. The remaining third of gastric symptoms are due to conditions not even located within the abdomen but existing entirely outside of this cavity as, a basilar meningitis, brain tumor, pulmonary tuberculosis, or exostosis associated with a lower thoracic vertebra. (The mechanisms by which these facts are explainable are discussed elsewhere.) Lesions at almost any point in the body may cause gastric symptoms through a direct or indirect involvement of gastric vessels and nerves. A list of such conditions, would necessarily be long and include general headings as endocrine disturbances, psychic disturbances, drug poisonings, abdominal allergies, etc. The ability of the diagnostician to arrive at a correct diagnosis will be limited unless he is thoroughly familiar with the many medical and surgical

Gastric Lesions vs.  
Epigastric Distress

conditions represented by the extensive list of actual causes. Given a patient, then, complaining of gastric symptoms, a complete study of all phases of the case is an obvious necessity

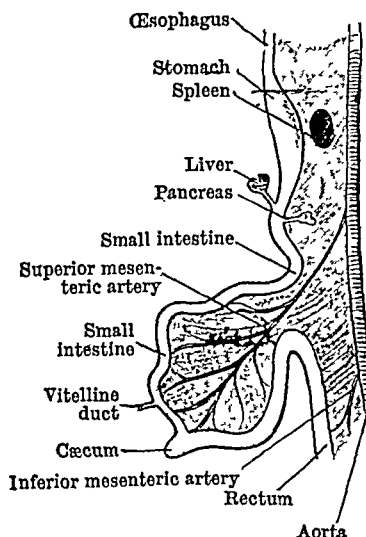


FIG. 95. The duct system of the liver arises as an outgrowth of the developing duodenum. (From Waterston. Cunningham's Anatomy.)

in arriving at a correct diagnosis. This means not only a thorough examination of all parts of the abdomen and pelvis but also of head, neck, thorax, extremities and of every region of the body; it involves not only a careful history but adequate laboratory tests as well. The abdominal spokesman simply tells of the presence of trouble; it remains for the diagnostician to definitely identify the organ or tissues diseased.

#### Chronic Dyspepsia and Gall Bladder Disease

There are, nevertheless, certain clinical rules and guides in dealing with epigastric distress which may be relied upon to a considerable extent as indicating, at the first examination of the patient, the true diagnosis. Perhaps the most common extragastric cause for epigastric distress is some affection of the biliary adnexa. The possibility of gallstone disease should always be borne in mind in any case of chronic indigestion. The bile ducts (endodermal portion) arise as an outgrowth of the developing duodenum (Fig. 95) and it might therefore be anticipated that if they produce, as do remaining portions

of the enteral tube, a reference of pain to the midline of the anterior abdominal wall, the site of this referred pain would either be some region between the surface zones for gastric and small intestinal pain or would coincide with that for duodenum. In other words, there are theoretical reasons why the pain with biliary tract disorders should be felt within the epigastrium. And the study of clinical records shows that in 20 to 40 per cent of cases of cholelithiasis and cholecystitis the site of pain is solely within the epigastrium.<sup>129,130</sup> In addition, when the chief complaint is right hypochondriac pain there is almost always some epigastric pain as well. There are reasons to believe that, regardless of its final radiations or other localizations, biliary duct pain (visceral pain unassociated with local peritonitis, adhesions, or other complications) is primarily epigastric. How often are unsuspected diseases of the gall bladder discovered during laparotomies? The fact that the anatomical area overlying the gall bladder itself is often not directly indicated by the symptoms is borne out by the considerable percentage of instances in which gallstones are clinically characterized as "silent." The records of these cases carry such statements as the following: "there were no preoperative symptoms referable to the gall bladder," "the complaints before operation were entirely gastric." In the absence of a typical biliary colic a diagnosis of "dyspepsia," "atonic gastritis," "chronic indigestion," is made with great frequency. Often it is only when a true "biliary colic" has occurred, with its right upper quadrant tenderness and rigidity and with the associated pain to the right shoulder, inspiratory dyspnea, and possibly jaundice, that attention is finally directed to the stone which for months or years had been causing varying degrees of epigastric discomfort or even, with the ingestion of fried, fat or greasy foods, of real epigastric pain. The so-called gastric symptoms of biliary tract disease are usually said to be due to a "reflex stomach" (viscero-visceral or vagus reflexes) and such gastric dysfunctions as hypermotility, hyperirritability, hypersecretion and pyloro-

spasm, may be demonstrated by fluoroscopic examination or the analysis of gastric contents; yet there seems clear evidence that in addition, or perhaps of even more importance

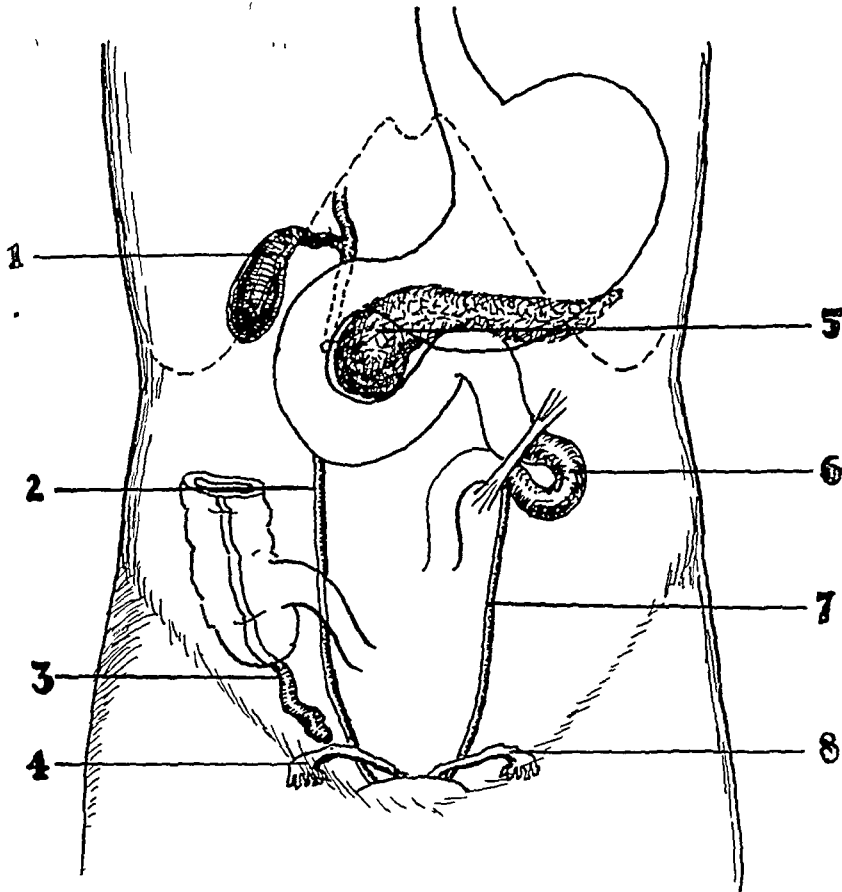


FIG. 96. Tubular structures often giving rise to colicky abdominal pains. (After Cope.)

1. Gall bladder and biliary ducts. 2. Right ureter. 3. Appendix. 4. Right fallopian tube. 5. Pancreatic ducts. 6. Loop of small bowel. 7. Left ureter. 8. Left fallopian tube.

in the production of epigastric distress, the gall bladder itself, without any reference to stomach dysfunctions, is capable of initiating epigastric pain.

The Nature of Colics

Colics occur almost exclusively in muscular tubes or in ducts of small caliber (Fig. 96), as biliary ducts, ureters, loops of small intestine, the characteristic intense intermittent pain being associated with strong peristaltic waves or smooth muscle spasms. Increases in intraluminal tension seem to be

an important factor in the causation of the typical colics. Since the stomach is a hollow muscular organ it might be anticipated that this organ would be the cause of pain of a cramp-like or colicky nature. Yet the typical gastric pain is not of this type and true colics from stomach affections are of rare occurrence. In his study of epigastric pain Mackenzie has gone so far as to state, "it will usually be found in the long run, that the so-called 'cramp in the stomach' in which there is pain of great severity referred to the epigastrium is due to gallstone colic. I have watched many patients for years who suffered from these severe attacks, and found that they *all* turned out to be cases of gallstone colic."<sup>127</sup> Colicky pain in the epigastrium, then, constitutes presumptive evidence of the presence of gallstones.

In those rare instances in which the stomach itself does undergo a sufficiently violent and massive contraction to cause pain of a colicky nature the resulting pain is not difficult to differentiate from the colics (right hypochondriac or epigastric) of biliary tract diseases. For when the stomach contracts as a whole there is implication of the cardiac as well as of the pyloric end of the organ and this causes pain which extends upward well over the sternum and to areas supplied by the fifth or even the fourth thoracic nerves. This pain not infrequently is associated with the regurgitation of acid gastric contents into the lower end of the esophagus and with the symptoms of pyrosis or heartburn. Because of the height to which it extends such pain has been mistaken for that of angina pectoris. Although the pain reference may be over the area of the heart the condition is but a pseudoangina for it is not related in any way to actual cardiac disease; pain, tenderness and hyperesthesia, such as extends into the arm with true angina, serve to distinguish the diseases and a complete study of the circulatory system combined with a good history should leave but little doubt as to the final diagnosis.

The characteristic pain of stomach lesions, particularly of ulcers, is dull, boring and deep-seated. It does not have either

Gastric Pain Simulating Angina Pectoris

The Pain of Peptic  
Ulcer

the intensity nor the spasmodic nature of a colic. In most instances it has a certain periodicity and its outstanding feature is a relation to the intake of food. While the time of onset of the pain after eating varies in individual cases, with the single case there tends to be an almost "clock-like" regularity in the onset of the discomfort after the taking of food.<sup>131</sup> A young individual who is hungry but afraid to eat because eating regularly sets up pain almost surely has a peptic ulcer. Ulcer distress is a quantitative dyspepsia rather than a qualitative dyspepsia as is seen with gall bladder diseases. The character of the food makes little difference; it is the fact that something is placed in the stomach which causes the distress; when the ulcer pain is severe even very small amounts of food uniformly initiate the symptom. The time of onset of pain bears a rough relationship to the distance of ulceration along the digestive tract. It has been stated that pain occurring immediately, or within a half-hour after eating, indicates ulceration near the esophagus, while that beginning from half-an-hour to an hour-and-a-half after the ingestion of the meal is probably indicative of a prepyloric lesion; and that when the postcibal pain is still later in onset the ulcer is likely to be duodenal.

Cycles or Rhythms  
with Peptic Ulcer  
Pains

This relationship to food has been termed "cyclic" in nature and Moynihan has spoken of a "rhythmicity" with peptic ulcer pain.<sup>132</sup> The rhythm with duodenal ulceration is triple and with gastric ulceration is quadruple. With duodenal ulceration the cycle is: food-relief-pain, food-relief-pain (a triple rhythm), for the discomfort begins so long after the ingestion of food as to be termed a "hunger-pain" and following the intake of food or alkalies there is a long period of relief. With gastric ulcer the rhythm is: food-relief-pain-relief; food-relief-pain-relief (a quadruple rhythm) for the pain wears off gradually before time has arrived for the ensuing meal and the period of relief after eating is so brief that the patient fears the effect from putting anything into the stomach.

These few clinical points relative to epigastric pains and to body-wall pains from gastrointestinal tract affections in

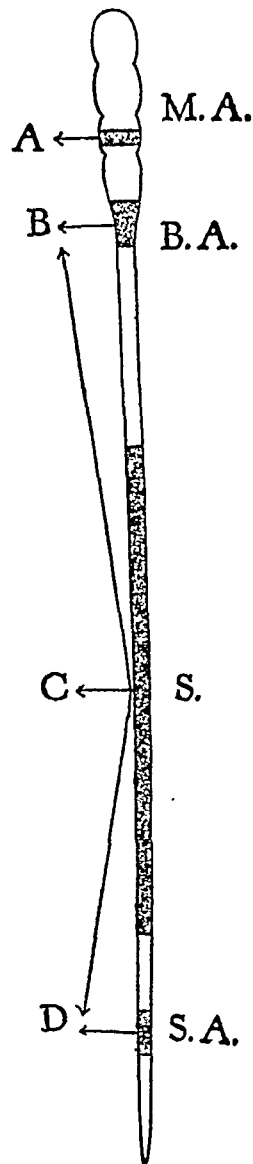


FIG. 97. Nerve supply of gastrointestinal tract. (From Langley.)

- a. Sphincter of iris. Ciliary muscle.
- b. Dialator of iris. Orbital muscle. Heart, Blood-vessels of mucous membrane of head. Walls of gut from mouth to descending colon. Outgrowths from this region of the gut (muscle of trachea and lungs; gastric glands, liver, pancreas).
- c. The skin (arteries, muscles, glands). Blood-vessels of gut between mouth and rectum, of lungs and of abdominal viscera. Arteries of skeletal muscle. Muscle of spleen, ureter, and of internal generative organs. Walls of stomach, intestine, gall bladder and ducts, urinary bladder.
- d. Arteries of rectum, anus and external generative organs. Walls of descending colon to end of gut. Walls of bladder and urethra. Muscle of external generative organs.
- MA. Mid-brain autonomic.
- BA. Bulbar autonomic.
- S. Sympathetic. (i. Th.-II. or III. L. in man.)
- SA. Sacral autonomic. (II.-IV. Sacral in man.)



Nerve Supply of  
the Digestive Tract

general have, perhaps, been rendered somewhat more readily understandable through the study of the development of the alimentary tube. A consideration of similar clinical rules regarding umbilical and hypogastric pains will be deferred in order that still other embryological arrangements, important in explaining everyday surgical matters, may first be investigated. A detailed review of the innervation of the gastrointestinal tract is reserved for a separate section (visceral neurology) where specific nerve connections and individual reflex pathways may be dealt with. Such additional study will make apparent that the reference of enteral pains to the tissues of the midline of the body wall takes place by way of the splanchnic nerves (sympathetic nervous system). The production of additional disturbances within the tissues of the body surface by way of the vagus nerves (autonomic fibers) will later be considered (reflex phenomena of scalp, temples, face, jaws, neck). The briefest summary of the nerve supply of the gastrointestinal tract might be stated as follows:

- a. A supply from the sympathetic system (splanchnic nerves) to stomach, small intestine and the greatest part of the great intestine.
- b. A supply from the bulbar autonomic system (vagus nerves) to the tract walls from the mouth to the descending colon.
- c. A supply from the sacral autonomic (nervus erigens or pelvic vagus) to the descending colon and rectum.
- d. A supply to the extreme cranial and caudal ends of the tract (derivatives of stomatodeum and proctodeum) from the cerebrospinal nervous system (Fig. 97).

## EPONYM

## JAMES BENIGNUS WINSLOW\*

Foramen of Winslow. Foramen epiploicum; a small orifice of communication between the greater peritoneal cavity and the omental bursa (lesser peritoneal cavity; Winslow's pouch).

Odeuse, Denmark, April 2, 1669.

April 3, 1760, aged ninety-one.

First studied theology in native land.

1697: Pre-medical studies in Holland.

1698: Continued studies in Paris.

Student of famous French anatomist Duverney who encouraged his natural inclination toward anatomy.

1702: Matriculated in University of Paris.

1703: Delivered thesis dedicated to Bossuet (French writer and orator) who, being ill, had himself carried to the university to hear the presentation.

1705: Degree, Doctor of Medicine, University of Paris.

1707: Presented to Royal Academy of Sciences by Duverney. Duverney had such confidence in his pupil that he often entrusted him with his lectures on Anatomy and Surgery at the Jardin du Roi. After the death of Duverney the chair at Royal Garden fell to Hunault, but later to Winslow. Winslow continued to fulfil this assignment as long as age permitted.

Eponymic not only with reference to the foramen epiploicum but also for Winslow's ligament (a fasciculus forming part of the posterior ligament of the knee joint ligamentum popliteum obliquum running from the tendon of the semimembranosus to the back part of the outer condyle of the femur) and for Winslow's stars (capillary whorls in the lamina choriocapillaris from which arise the venae vorticosae). Winslow did much to systematize the anatomical knowledge of his time, particularly in reference to myology.

Among his published books and papers were:

1711: Observations sur les fibres du coeur et sur les valvules, avec la manière de la préparer pour le démontrer. *Mem. de l'acad. d. Sc.*

1715: Nouvelles observations anatomiques sur la situation et la conformation de plusieurs visceres. *Mem. de l'acad. d. Sc.*

1717: Description d'une valvule singuliere de la veine cave, et nouveau sentiment sur la fameuse Question du trou ovale.

1729: Observations anatomiques sur la rotation, la pronation, la supination, et d'autres mouvements en rond.

1732: Exposition anatomique de la structure du corps humain. Paris, also English, German and Italian versions.

1742: Dissertation sur l'incertitude des signes de la mort. Paris.

Exposition anatomique de la structure du corps humain, Paris, 1732, 2: 170, 352-365.

Winslow tested the communications of the foramen bearing his name by the ingenious method of inserting into this opening a quill or pipe, well fitted to the orifice, and then after blowing through the quill, observing the course and distribution of the air. He found that air distended the greater omentum, filling it like a bladder or balloon.

The surgeon seldom thinks of the great omentum as being "a bladder" and only sees the potential space within the omentum filled when, for example, loops of small bowel have passed through the foramen epiploicum (hernia through foramen of Winslow) or when blood or gastric contents occupy the cavity after injury to or perforation of

\* See photostat regarding first name.

Eponym:

Nativity:

Death:

Education:

Connections:

Writings:

Source of Eponym:  
Discussion of  
Eponym:

# EXPOSITION

## ANATOMIQUE DE LA STRUCTURE DU CORPS HUMAIN,

PAR M. WINSLOW, Docteur-Régent de la  
Faculté de Médecine de Paris, Interprète de la  
Langue Teutonique à la Bibliothèque du Roi,  
Ancien Professeur d'Anatomie & de Chirurgie  
au Jardin Royal, de l'Académie Royale des  
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NOUVELLE EDITION, faite sur un Exemplaire corrigé  
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nouvelles Figures & Tables qui en facilitent l'usage,  
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P. F. DIDOT le jeune, }

M. DCC. LXVI.

Avec Approbation & Privilège du Roi.

A

FIG. 98. A. Facsimile of title page of volume II of French edition of Winslow's work con-  
taining his description of the foramen epiploicum.

B. Title page of English translation of Winslow's work, by G. Douglas.

AN

## ANATOMICAL EXPOSITION

*The Property* OF THE *Académie de Médecine*

## STRUCTURE

OF THE

## HUMAN BODY.

By JAMES BENIGNUS WINSLOW,

PROFESSOR OF PHYSICK, ANATOMY AND SURGERY,  
IN THE UNIVERSITY OF PARIS,

MEMBER OF THE ROYAL ACADEMY OF SCIENCES,  
AND OF THE ROYAL SOCIETY AT BERLIN, &c.

TRANSLATED FROM THE FRENCH ORIGINAL,

By G. DOUGLAS, M.D.

Illustrated with COPPER PLATES

VOL. II.

The FIFTH EDITION, corrected.

B



DEDICATION.

T O

*Dr.* JAMES DOUGLAS.

S I R,

**W**HAT I here take the Liberty to offer You, is already more Your own than mine. To You I owe all that I know, not only of the Science, but of the Style of Anatomy; and there is not one good Line in this Translation, which is not the better for what You have taught Me, or procured Me Opportunities of learning. These are very great Obligations to a Man resolved to live by the Profession of Physick; but they are very small, when compared with others that You have laid Me under, without which I should never have been in a Condition to live by any Profession. Pardon this publick Acknowledgment of Favours which You designed to have kept always secret; and continue to believe Me with the utmost Sincerity, Gratitude and Respect,

S I R,

Your Most Dutiful,

Bow-Lane,  
Sept. 5, 1732.

Most Obliged Brother,

G. DOUGLAS.

Fig. 99. Unusual dedication to English edition of Winslow's work, in which G. Douglas pay a beautiful tribute to his brother James Douglas.

*Situation,  
Desires, and  
Concerns of  
the Operator.*

352. The Omentum is a large, thin, and fine membranous Bag, surrounded on all Sides by numerous Portions of Fat, which accompany and even invest the same Number of Arteries and Veins adhering closely to each other.

353. THE greatest Part of it resembles a Kind of flat Purple, or a Sportsman's empty Pouch, and is spread more or less on all the small Intestines from the Stomach to the lower Part of the Regio Umbilicalis. Sometimes it goes down to the lower Part of the Hypogastrium, and sometimes it does not reach beyond the Regio Epigastrica. It is commonly plaited or folded in several Places, especially, *hæc glandula in 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820*

354. It is a right a into two Bor Side of the A the Stomach.

Side is fixed to the common Ligament or Aneurion of the Duodenum and Colon, and to the contiguous Parts of these two Intestines. That on the left Side is fixed to the longitudinal Sciffure of the Spleen, to the Extremity, of the Pancreas, and to the convex Side of the great Extremity of the Stomach. It is likewise fixed to the membranous Ligament, which sustains the Ductus Cholidochus, and connects it to the Vena Portæ Ventralis.

355. BELOW these Adhesions the other Portions, that is, the anterior, posterior, two lateral and inferior Portions, which last is the Bottom of the Sacculus Epilpticus, have commonly no fixed Connexions; but he who has seen the Brain in its Situation, will find it very difficult to call them Folia, Alar, or some such Name.

356. The number of  
up of two  
ity of wh  
where accompanies.

Fat according to the Copiousness of the Subject, and for that Reason I have called them Bands or Portions of Fat.

357. *Porta hepatica*, the *Porta hepatica* (the *Porta hepatica*), the only in the *Porta hepatica* (the *Porta hepatica*), the little *Porta hepatica* (the *Porta hepatica*), partly of the Liver, before the sinus of the Vena Portæ, to as to surround and contain the prominent Portion of the Lobulus.

358. The little Omentum is thinner and more transparent than the other, and its Cavity diminishes and all of a sudden it is lost.

(C) is composed of two Laminæ, with a Mixture of the same Portions of Fat, which are considerably finer than the other.

Portions of Fat, which are considerably thinner than the others.

FIG. 100. Facsimile of English translation  
epipl

the posterior wall of the stomach. At other times the great omentum resembles a caul or great apron overlying the small intestinal loops (flat). Winslow's observations in regard to distention of the great omentum by air may be verified, however, providing the experimenter moisten his fingers in oil as directed, when handling the parts.

Study of the original words of Winslow is rendered difficult for the modern student by reason of the fact that Winslow uses the term "lesser omentum" in a different sense from that in which it is now employed. The "lesser omentum" of this author corresponds to the omental bursa (lesser peritoneal cavity) of the present. When Winslow's writings are reviewed, substituting "omental bursa" for "lesser omentum," the descriptions become more readily intelligible.

Winslow seems to have been the first to employ the term omentum in its present sense. He describes the cavity of the great omentum as resembling a "sportsman's purse or bag"; and much might be said in favor of his method for describing the omental bursa, and for terming this space and its peritoneal coats a "lesser omentum." Thus a hand introduced through an opening in the gastrocolic or great omentum lies within the large "sportsman's pouch" whereas a hand introduced into an opening in the present lesser omentum (above the stomach) (through the gastrohepatic omentum) would lie in the smaller "sportsman's pouch." These two "pouches" would be found to communicate with each other, as described, and to open in common through the foramen epiploicum into the general or greater peritoneal cavity.

Although the photostat of the English Translation of Winslow's "Exposition Anatomique" shows the first name James, dictionaries and medical histories variably use the first names James, Jacob, and Jacobus.

In beginning his medical studies Winslow was granted financial aid or "a pension" by the government of Denmark, in order "that the country might not be without participation in the glory of advancing the progress of anatomical knowledge." Later he received financial aid from the Bishop of Meaux. The Bishop died in 1704 (one year prior to Winslow's graduation). Deprived of aid Winslow addressed himself to the faculty of the University of Paris "which was not deaf to his pleas but even paid all his expenses for the rest of his course."

Winslow's father and grandfather were Lutheran pastors and Winslow first studied for the ministry. He then turned to the study of medicine and finally forswore the religion of his fathers to turn Catholic. He was, therefore, disinherited by his family.

It has been written that Winslow's exposition on the structure of the human body was the "first treatise of descriptive anatomy divested of hypothetical physiological details and explanations foreign to the subject" and that his work represented a "close description derived from actual objects rather than from reference to the writings of previous anatomists."

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Points of Interest:

Special  
ences:

Refer-

#### QUESTIONNAIRE

1. What is the mechanical effect of the loss of abdominal fat?
2. Name some of the functions of intra-abdominal fat.
3. Why does it often prove so difficult to reduce a large umbilical or ventral hernia?
4. What special preoperative care is advisable in treating fat patients who have large ventral hernias?

5. What is meant by static pressure?
6. Explain some of the interrelationships between intravisceral, intraperitoneal and static pressures.
7. Discuss the effects of gravity in regard to the Fowler position, the Trendelenburg position, the knee-chest position.
8. What is meant by the cushion effect of air-containing organs?
9. What is the effect of an increase in the pressure exerted upon an organ containing fluid; one containing gas?
10. Explain the effects of gravity upon hernial masses.
11. Why do organs herniate both downward through the inguinal rings and upward through the diaphragm?
12. What is meant by garrulity of the vulva? Give the mechanism by which this phenomenon is produced.
13. What is the value of the knee-chest position?
14. State the instructions to be given to a woman who is to take the knee-chest exercise.
15. What is the habitus enteropticus?
16. What is visceroptosis?
17. What is the intra-abdominal condition found to be present with a congenital visceroptosis?
18. Why do patients with visceroptosis have sharp intercostal angles?
19. What are the chief symptoms of visceroptosis? Their cause?
20. State some of the methods for replacing and retaining in position prolapsed abdominal viscera.
21. What are some of the causes of acquired visceroptosis?
22. What are the chief differences as to symptoms and treatment between congenital and acquired visceroptosis?
23. What is the usual effect of pregnancy upon the symptoms of visceroptosis?
24. Give the technic of one or more methods for supporting the abdomen by means of adhesive dressings in the treatment of visceroptosis.
25. What requirements must be fulfilled by an abdominal belt as used in the treatment of visceroptosis?
26. What exercises are of particular value in the treatment of visceroptosis? How do these act to prove the condition of the patient?
27. Give a list of from 5 to 10 factors which have an important bearing upon pressure conditions within the abdomen.
28. Is the peritoneal cavity an actual or a potential space?
29. What effect has opening the peritoneal cavity upon the tensions between the various abdominal viscera and between the viscera and the abdominal walls?
30. When is it correct to use the term intra-abdominal pressure? What are the objections to the term?
31. Of what importance is it in instituting treatment to correctly interpret among the many forces active, the actual cause or causes of any abnormal pressure conditions within the abdomen?
32. What is the length of the alimentary canal? What factors seem to necessitate this extreme length?
33. What is the derivation of the following terms; intestine, alimentation, digestion?
34. From what primary germ layers are the following tissues derived; inner lining of enteric canal, skin, peritoneum, nerves of intestinal tract, muscles of intestinal walls?
35. What is meant by the following terms; yolk sac, yolk vesicle, vitelline duct, omphalomesenteric canal, omphalomesenteric vessels, Meckel's diverticulum, archenteron?

36. What is the primary loop of bowel; name the parts of this loop. What is the foregut, hindgut, midgut?
37. Why does a loop of gut protrude into the umbilical cord in early embryonic life?
38. Explain with sketches the embryological development of the gastrointestinal tract.
39. What is the normal incidence of a persistent omphaloenteric duct?
40. What are the various shapes in which Meckel's diverticula may occur?
41. What is the usual length of a Meckel's diverticulum? What is the average distance from the ileocecal valve for the attachment of the diverticulum to bowel? How much variation is there as to the site of this attachment?
42. What vessels may accompany a Meckel's diverticulum? What are the origin and function of such vessels?
43. In what ways do acquired diverticula of bowel differ from congenital diverticula?
44. Contrast acquired and congenital diverticula on the following points; number, shape, size, position, structure, age incidence, potentialities.
45. What is a false diverticulum?
46. Name several ways in which a Meckel's diverticulum or persistent omphalomesenteric vessels may cause intestinal obstruction.
47. What is a diverticular knot? Sketch some of the more common types of congenital diverticula and the more common intra-abdominal complications they may cause.
48. Why are pains from gastrointestinal affections most often referred to the midline of the anterior abdominal wall?
49. To what areas are pains referred from affections of the following structures; esophagus, duodenum, biliary ducts, ileum, jejunum, cecum, appendix, colon, rectum? Why do these cause pains limited to the areas described?
50. Where is the primary pain of the following conditions most likely to be referred; volvulus of sigmoid colon, herniation of small bowel into fossa of Treitz, gastro-mesenteric ileus, biliary colic, duodenal ulcer, gastric ulcer, acute esophageal dilatation, diaphragmatic pleurisy, appendiceal colic, Deitl's crisis, embolism of superior mesenteric artery?
51. What evidence is there that pains due to visceral affections are referred to skeletal tissues and that the pain is not actually referred to the involved viscus itself?
52. What are the chief zones found by Mackenzie as the sites for referred pains with gastrointestinal affections?
53. What accounts for the inequality between the length of the body wall zones to which pain is referred from various units of the alimentary canal and the length of the bowel divisions themselves?
54. Why is large bowel pain felt at a lower point than small bowel pain when the large bowel reaches to the hypochondriac regions while the small bowel lies in part within the pelvis?
55. At what period in development are nerve pathways in the gastrointestinal tract determined? Do these early central nerve connections change in later life? If so, how?
56. What percentage of gastric symptoms are due to actual gastric lesions?
57. What are the chief extragastric causes of gastric symptoms?
58. What is meant by terming the stomach "the abdominal spokesman?"
59. How do the following conditions cause alterations in gastric motility and secretory activity; brain tumor, basilar meningitis, cholelithiasis, tabes mesenterica, Pott's disease?
60. Along what broad lines are gastric lesions to be differentiated from extragastric conditions causing gastric symptoms?
61. What is meant by "silent gallstones?"



62. What percentage of the distress with cholelithiasis and cholecystitis is epigastric in location?
63. Describe a typical biliary colic. What are the chief associated symptoms?
64. What is meant by a "qualitative dyspepsia;" a "quantitative dyspepsia?"
65. What are the characteristics of a colicky pain? Causes?
66. What is the usual cause of a severe epigastric colic?
67. What is the site of the colicky pain due to a massive or generalized contraction of the stomach?
68. How may gastric affections simulate angina pectoris?
69. What is the typical pain with peptic ulcerations?
70. Explain the relationship between ulcer pain and the ingestion of food.
71. What is meant by a "rhythm" or "cycle" in ulcer pain?
72. What is meant by the "triple rhythm of duodenal ulcer pain" and the "quadruple rhythm of gastric ulcer pain?"
73. By what nerve pathways are pains of gastrointestinal tract origin referred to the forehead, scalp, jaw and neck?
74. Briefly describe or sketch the innervation of the gastrointestinal tract.

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